RADIO, TELEVISION and HOBBIES

Volume 23, Number 2 **May, 196**

CONGRATS. TO I.R.E.

ALTHOUGH rather belated, by reason of our publication dates, I take the opportunity of congratulating the Institution of Radio Engineers, Australia, on their Convention and Exhibition, held recently at the Chevron Hilton Hotel in Sydney. The large number of technical papers presented, their standard and the diversity of subject matter reflected credit, not only on the Institution which promoted the Convention but on the radio and electronics industry as a whole.

I must also congratulate the firms and organisations which co-operated with the I.R.E. to produce such an impressive display of electronic equipment, both imported and locally manufactured.

An interesting facet of the convention was the diminished attention given to the design and display of "domestic" items. Radio, audio and even television seemed almost to be swamped out by sophisticated test gear and a wide variety of other electronic equipment. It was proof indeed, if proof was needed, of my statement last month that "radio has now become electronics, with a potential penetration into almost every phase of modern life and work."

In the face of all this, it is rather depressing to observe the spirit with which some firms are meeting the present crisis, occasioned largely by the recession in domestic television sales. Their philosophy is apparently to hibernate, in the hope that they can awaken to a new and brighter future some time hence. Unfortunately, they may awaken to find that someone else has stolen a march in the meantime.

Now is the time to keep the name alive — while business is dead; to maintain the basis on which sales will inevitably build as winter sets in. Now is the time, also, to investigate every possible avenue of sales for the next summer period. The public is really not short of money, nor is it likely to be. But it has to be induced to spend it!

W. N. Williams

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COVER PICTURE

Our cover picture for the month was taken by Qantas photographer Warren Clarke. It shows two of the Company's Boeing 707s lined up on the tarmac of Sydney's Kingsford Smith Airport. From the original "Queensland and Northern Territory Aerial Services," Qantas has built into one of the world's major international airlines, with an enviable record of safety and service. Plans are well in hand to fit the 707s with turbofan engines, which will boost their performance and, along with new color treatment, considerably change their appearance.

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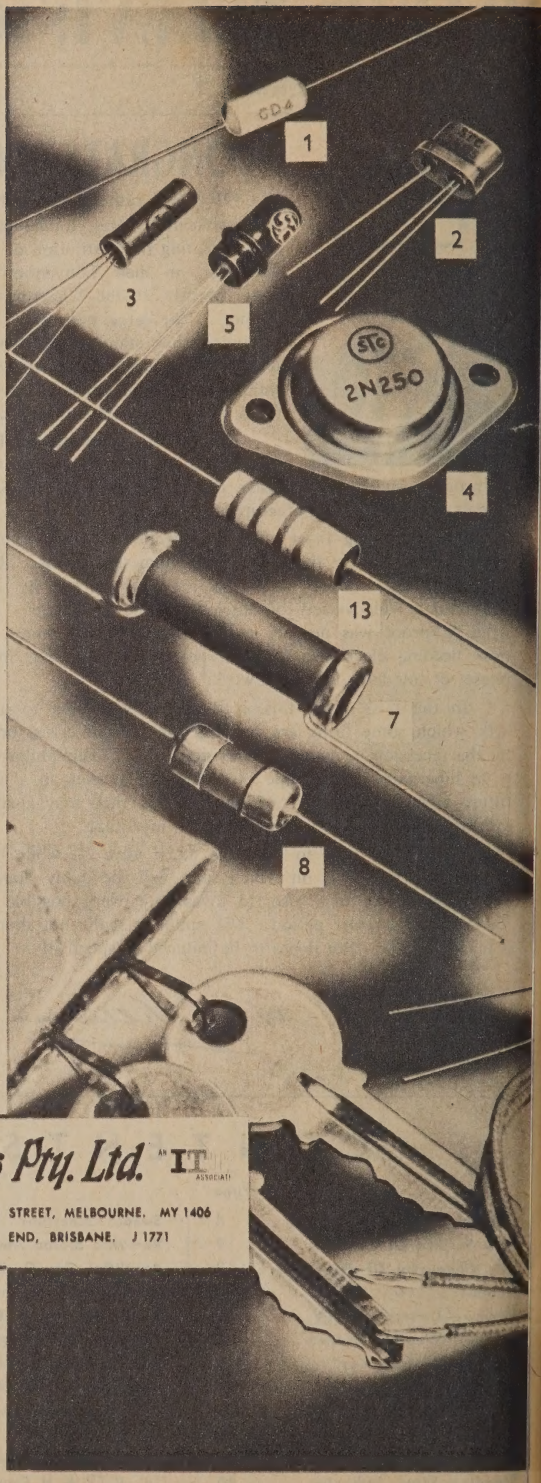

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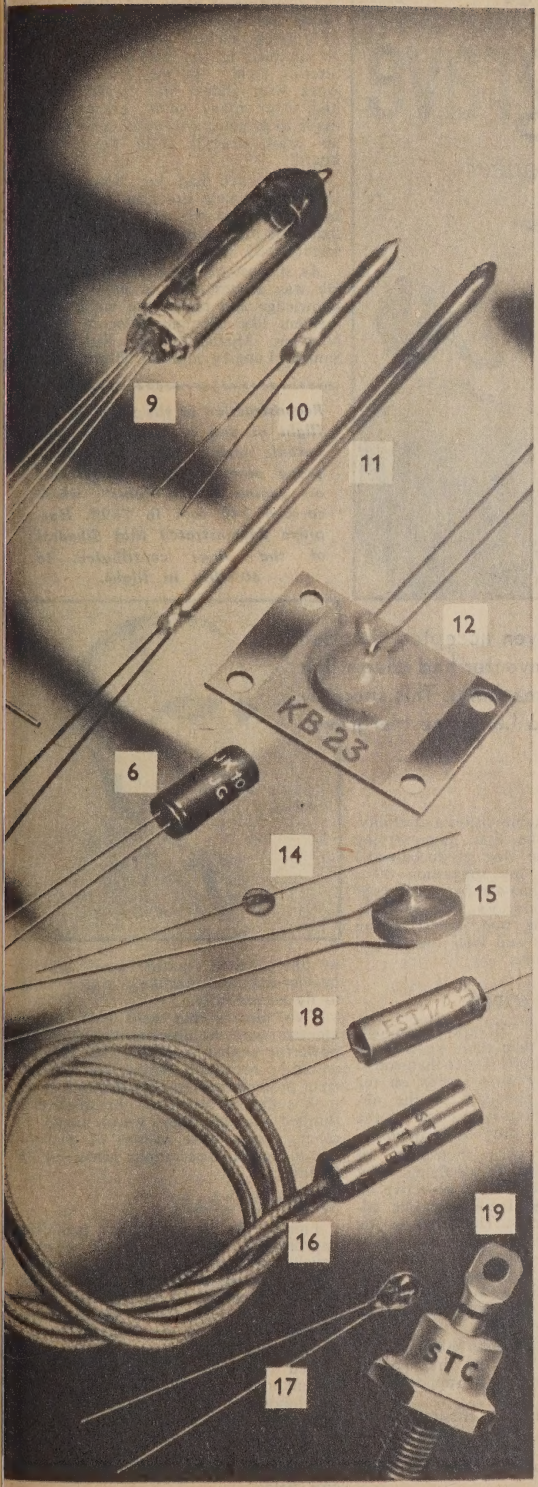

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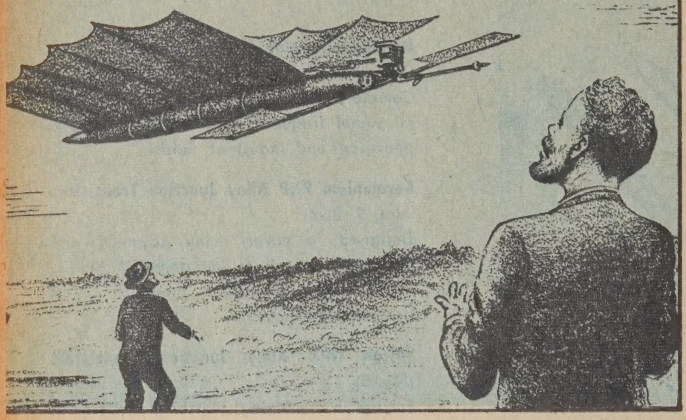
STC

Visionary and Experimenter

Lawrence Hargrave

Australia's Aeronautic Pioneer



Reconstruction of the scene at the flight of one of Hargrave's most notable models; this was a monoplane powered by a compressed air engine driving "oars", which covered 340 feet in 1890. Hargrave demonstrated that dihedral of the wings contributed to stability in flight.

Long before many of his compatriots had even accepted the idea of a "horseless" road vehicle, an Australian inventor had caught the vision of flight in powered, heavier-than-air machines. This specially written article is a tribute to that man — to Lawrence Hargrave.

By R. Michel

AFTER many years of negotiation, eleven models made by Australian aeronautical pioneer Lawrence Hargrave between 1880 and 1890 in his search for a practical flying machine have recently been returned to Australia from Germany. They are now in the possession of the Museum of Applied Arts and Sciences, Sydney.

Until their return, the models were on exhibition in the Deutsches Museum, Munich. Hargrave sent them to Germany in 1910, as a result of the interest shown in Europe in his work early in the century.

Now that they have been returned, Sydney's Museum of Applied Arts and Sciences holds an almost complete collection of the remarkable models Hargrave made—models based on investigation and work that were to influence the early British and European aircraft designers.

INTENDED FOR MUSEUM

At one stage Hargrave himself intended that all his models were to be donated to the Sydney Museum. From the correspondence that passed, they should have been placed in the Museum in the first place. For some reason, still unknown, he changed his mind—or had it changed for him—at the last moment and eleven of the best of his models were shipped to Germany.

Between 1878 and 1900, Lawrence Hargrave undertook many aeronautical experiments which stamp him as a scientist of remarkable vision and ability.

Long before the first man-carrying powered aeroplane was produced—and at a time when any suggestion of a practical heavier-than-air flying machine was ridiculed—Hargrave was patiently designing, building and experimenting with flying models and kites that reveal his prescient qualities.

SEEM FAR REMOVED

Small and frail, Hargrave's models seem much more than three generations removed from today's faster-than-sound aircraft. Yet they were a step on the ladder to man's conquest of the air, and they stamp Hargrave as one of the great names in the story of aeronautics.

For hundreds, even thousands, of years, man had dreamed of flying. Yet it seemed an unattainable objective in spite of technological and scientific advances in other fields. Then, late in the nineteenth century there was an upsurge of interest in the possibility of devising a successful flying machine by the application of scientific knowledge to the subject, instead of the vague and fanciful hopes of the dreamers.

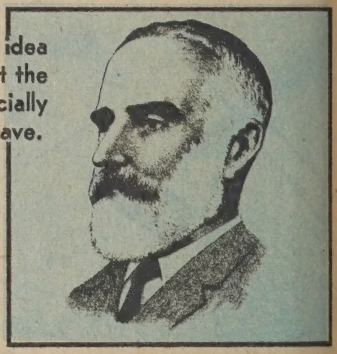
As early as 1848 John Stringfellow, in London, had built the first power-driven model aeroplane to support itself in flight.

A few years later—in either 1853 or 1854—Sir George Cayley had built a glider which had flown, with a passenger, in the first manned heavier-than-air flight in history.

In fact, this promising effort had limited significance; more had to be learned about the basic characteristics required of a flying machine before success could be attained in the search for a viable aircraft style. In the event, Cayley's work with gliders was largely ignored and, over many years, attempts were made to produce a powered heavier-than-air craft straight from the drawing-board.

If Hargrave had not been working in such complete isolation, he may well have succeeded where others were failing. His approach to the problems was scientifically constructive.

As it was, he came close to success. He was accumulating a great store of knowledge and experience while experimenters like Clement Ader in France, Nicholas Mozhaisky in Russia, and Samuel Langley and Sir Hiram Maxim



in the United States were building heavier-than-air machines which failed to fly successfully.

Two factors that held back experimenters were the absence of a light and powerful engine, and the fact that the would-be aeronauts neither put in sufficient preliminary research themselves nor took sufficient notice of the discoveries (limited though they were) made by others. There were visions of genius—but the great expectations remained unfulfilled.

GLIDING CRAFT

Late in the 19th century a promising approach to mechanical flight began to develop through the detailed investigation of gliding craft. As well as Hargrave, those who contributed to it included Otto Lilienthal in Germany and Octave Chanute in the United States.

Lawrence Hargrave, for his part, displayed all the qualities of the practical, patient and scientific experimenter. He was labouring under even greater handicaps than his contemporaries because of the isolation in which he was working—yet he overcame such limitations and achieved remarkable gains in his own fields.

Born in 1850 at Greenwich, near London, Hargrave came to Australia as a youth, joining his father in Sydney in 1866. Soon after his arrival he was apprenticed as a draughtsman with the Australasian Steam Navigation Company. In his work he gained technical proficiency that was later to prove extremely valuable when he was constructing his model flying machines.

A few years later he joined an expedition which was setting out to do some exploration in New Guinea. On his return he held an appointment at Sydney Observatory, where he was engaged from 1878 to 1883.

Hargrave was constantly in search of answers to the secrets of Nature and, as he had moderate independent means, he decided to resign from his post and devote his whole time and energy to research and experiment in the quest for a flying machine.

STUDIED NATURE

First he studied and sketched the movements whereby birds, fishes and insects propel themselves. He also studied the method of propulsion adopted by the earthworm—and this he found to be of three-dimensional character, similar to that of large bodies moving through the air.

He constructed a large model of the worm, made up in sections, and by means of radial wires attached to certain points he recorded the curves along which these points travelled during the forward motion of the whole model. From these records he prepared an address which he delivered to the Royal Society of New South Wales late in 1884.

Hargrave also spent a good deal of time on the study of sea waves and air currents, and he began experimenting extensively with small flying monoplane models. These he constructed mainly from paper on a framework of wood.

The earliest were driven by oar-like flapping wings moving with the "figure-8" sweep peculiar to a bird's wings in flight. He overcame the great difficulties encountered in mounting the propelling mechanism capable of providing such movement, and his experiments proved successful as, stage by stage, he increased his theoretical knowledge and his ability to build improved machines.

By June, 1885, tests carried out with nearly 50 models had resulted in the building of small machines able to sustain themselves in the air and propel themselves forward.

A model exhibited to the Royal Society in Sydney late in 1885 flew 120ft at a speed of 14 m.p.h. It was powered by rubber bands and weighed 24oz.

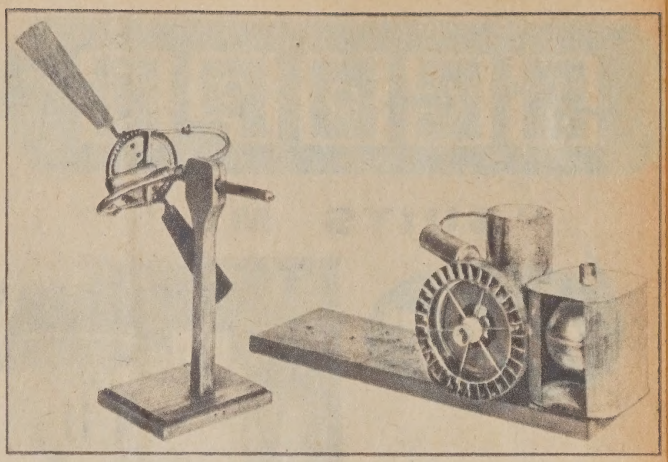
USED PROPELLERS

Another model machine built about this time flew 170ft.

On some of his models Hargrave used screw-type propellers similar in principle to those used on propeller-driven aircraft of today.

The motive power was at first clockwork, then rubber bands, then compressed air, and finally steam. While he moved through these phases, Hargrave retained both forms of propulsion, screw-type propeller and flapping oars, on different models since he found both to be about equally efficient.

In 1890, a flight of 368ft was made by one model of the flapping-oar type, powered by a compressed air engine.



Two of Hargrave's models. At left is an airscrew, driven by a steam turbine. At the right is a steam reaction turbine built in 1886 (incomplete).

By his prolonged experimenting, Hargrave established the superiority of wings set at a dihedral angle—that is, with wings forming a shallow "V." He found that this produced a greater stability in flight.

FULL-SIZED VENTURE

In June, 1887, Hargrave built a full-sized machine, on wheels, in order to determine the dimensions of an aircraft sufficient to bear a man's weight. Propulsion was to be by means of "oars" driven from a hand-operated wheel. The whole experiment failed, but it served to demonstrate to Hargrave that the power needed for human flight was far beyond that attainable by manual effort. Faced with the problem that baulked other air pioneers, lack of a suitable engine, Hargrave decided to design and build his own. He showed remarkable ingenuity in this.

Using steam, an engine which he constructed developed power on the scale of about one horsepower to 10lb weight of engine—a considerable achievement for this time.

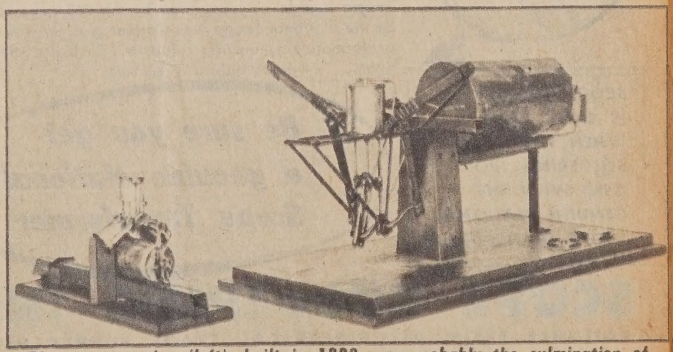
In the course of his experiments Hargrave invented a rotary engine which provided considerable power without great weight. A three-cylinder screw engine turned on the boss of the propeller crankshaft and drove a three-bladed airscrew.

He also used the fixed radial type of engine. One that he used on a flying model weighed only 7¼oz and made 4,560 revolutions a minute.

Already his mind was fixed on the possibility of larger flying machines and on the problems of their control in the air. For one-man craft, he thought movements of the pilot's body would be sufficient—as some of the pioneer gliding experimenters later found to be the case.

ADJUSTABLE TAIL

For larger machines, however, Hargrave proposed use of a movable tail unit—again showing his thorough understanding of many of the problems to be overcome in attaining a workable aircraft.



The steam engine (left), built in 1888, was probably the culmination of Hargrave's experiments to develop a flying machine utilising wing movement. These experiments were abandoned about this time. He switched his attention to fixed wing machines driven by propellers but, because they lacked stability, he undertook other experiments which led to his achievements with the box kite. At the right is a three-cylinder motor for experimental flight models.

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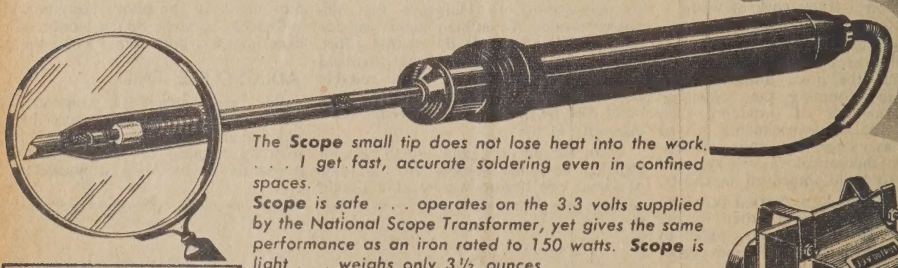

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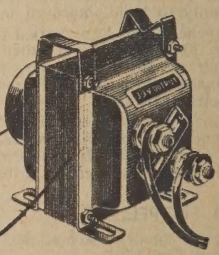

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About 1892 Hargrave began to experiment with curved wing surfaces to obtain greater "lift." He attached a curved wing surface to one of his models and the little machine then had so much lift that it looped the loop twice before falling to the ground.

He carried out a considerable amount of work on the value of suitably curved surfaces and, although he was not the first to discover the principle, he established the effectiveness beyond all doubt.

He found that the increased lift obtained with concave-convex wing surfaces opened up a new and enlarged field for research in the production of his great invention—the cellular box kite. This was the type of kite in which two separate "cells" or double planes were mounted tandem fashion. Such a device, he showed, had the greatest stability and soaring power.

TWO-CELL KITE

The most efficient kite, constructed in 1893, had two rectangular cells separated by a distance of 21 inches. Such a kite with curved surfaces was found to exert twice the lift of one in which the surfaces were flat.

By using four kites weighing 35lb, Hargrave succeeded in raising himself some 16 feet into the air in a 21mph wind on the beach at Stanwell Park in November, 1894. Greater lift would have been obtained but for the fact that, because of the difficulties in the way of constructing curved surfaces that were sufficiently rigid, he had to use substantially flat surfaces for the kites.

Reporting on this experiment, he showed vision when he said, "A safe means of making an ascent with a flying machine . . . and descending, are now at the service of any experimenter who wishes to use it." The use of tethered lifting surfaces in steady wind proved to be the way to success in the search for successful aircraft; it was used by experimenters overseas.

The box kites that Hargrave designed were his most significant and enduring innovation and it is upon his work in this field that his place in aeronautical history chiefly rests. These box kites produced far greater lift and possessed greater stability than any apparatus previously discovered for artifical flight. Some of the early 'planes which became famous in the fledgling days of aviation were based directly upon them.

Hargrave returned to work on model aeroplanes and in his experiments he found that a vertical tail fin improved the stability of the machine in the air.

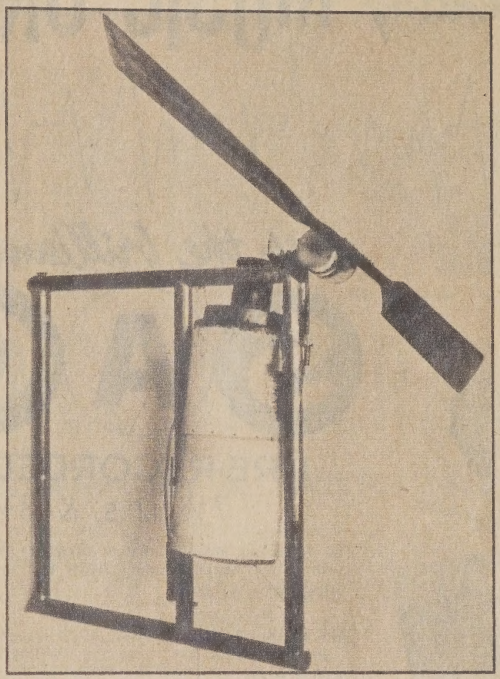
In 1899 Hargrave visited London, where he read a paper and displayed models before the Aeronautical Society of Great Britain.

MAINTAINED INTEREST

After 1903 he did less aeronautical work but he maintained his interest in the subject. His last paper on aeronautics appeared in 1909. However, from evidence in the possession of the Sydney Museum, including an aeroplane engine model, it is clear that he and his son collaborated on aeronautical work up to 1914 when his son, a promising young engineer, enlisted in the A.I.F.

It is difficult to evaluate the importance of all Hargrave's discoveries as a contribution to the eventual conquest of the air. There has been considerable controversy on the issue. As Hargrave himself refused to patent any of his inventions, believing they should be common property for the benefit of mankind, formal tracking of developments from his work is made difficult.

The Wright brothers denied that they owed anything directly to Hargrave, and the Seguin brothers have stated that the Gnome rotary engine (significant in the early days of flight) was developed by them without any knowledge of Hargrave's earlier parallel invention.



A twin cylinder rotary engine developed by Hargrave in 1880. The tubular framework supporting the boiler also serves as a water reservoir. Using methylated spirit or other suitable fuel, steam was generated in spiral tubes inside the insulated cylinder, then fed to the engine through a hollow shaft. Admission of steam to the cylinders was controlled by a centric shaft actuated by the engine's own rotation.

MAJOR PART

Nevertheless, it is clear that Hargrave's discovery of the cellular kite and his investigations into the superiority of curved wing surfaces played a major part in the direction of European experimental work which led to the world's first public flight — that by Alberto Santos-Dumont in France in 1906.

Santos-Dumont's machine comprised, fundamentally, two box kites. Many early British and Continental aircraft designs were similarly derived from Hargrave's kites.

It has become clear with the years that Hargrave's work did not directly influence the Wright brothers in their designs. On the other hand, Hargrave did write to Octave Chanute, an influential experimenter of the 1890s, and some of Hargrave's discoveries were included in Chanute's book, **Progress in Flying Machines,** published in 1894.

Again, it is abundantly clear that the models which Hargrave sent to Germany were a factor in Germany attaining aerial supremacy in the early days of World War I.

Meanwhile, attainment of flight by the Wrights in the United States (in 1903) and by Santos-Dumont and others in Europe had brought changes in the direction of research and experiment so that control of future progress passed more and more from the hands of the pioneer experimenters and into those of the younger engineers.

Lawrence Hargrave's son, Geoffrey, was in the Gallipoli landing, and in May, 1915, he was killed. The loss proved a grave blow to his ailing father, and, after a brief illness, Lawrence Hargrave died on July 6, 1915.

His work has been commemorated by a memorial erected at Bald Hill, Stanwell Park, Sydney, scene of many of his experiments with kites and models. In 1952 the Lawrence Hargrave Chair of Aeronautical Engineering was established in the University of Sydney.

In his own day, Lawrence Hargrave gained only limited acknowledgment for his efforts. Nevertheless, it is to the credit of the Sydney Museum that it has always recognised his place in aeronautical science.

Hargrave was fully aware of the Museum's interest in his work, and he was a frequent visitor. He went so far as to build a replica of one of his models especially for the Museum. The permanent display of an important group of his models—all those that were not sent to Germany — indicated the continuing support accorded Hargrave's work.

It is true to say that Lawrence Hargrave made a notable contribution to the development of aviation during the period when anyone who believed in the possibility of flight, much less undertook detailed and patient research aimed towards it, ran the risk of being regarded as, at best, a crank.

Hargrave's work, which was noted overseas, helped to strengthen the growing conviction among the dedicated that man could fly in a mechanically propelled heavier-than-air craft. Hargrave never wavered in his view of the importance and the practicality of such an objective.

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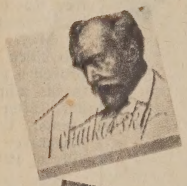

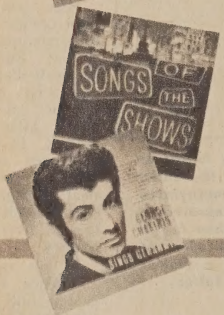

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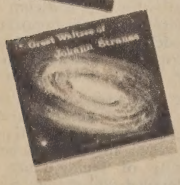

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Useful ceramic products have been made from naturally occurring silicate minerals since at least 4500 B.C. Ceramics is thus one of the oldest arts known to man. Research of one form or another has been going on in ceramics during this entire time. Why, then, speak of a "new science" of ceramics? What is the difference between the "new" and "old" ceramic sciences?

THE answer lies in the development during the past two decades of a whole new class of ceramic materials that are distinctly different from the traditional ceramics, such as pottery, porcelain and glass. These new materials have special properties needed for applications in nuclear energy, electronics, jet engines, rockets and other new technologies.

Some examples are uranium dioxide as a reactor fuel; aluminium oxide and graphite for high-temperature structural purposes; heavily doped magnetic core for high-frequency transformers; radiation-resistant glasses; and ceramic-metal composite cutting tools. Since most of these materials are fabricated by high-temperature processes at least superficially similar to those used in traditional ceramics, they have all come to be called ceramics.

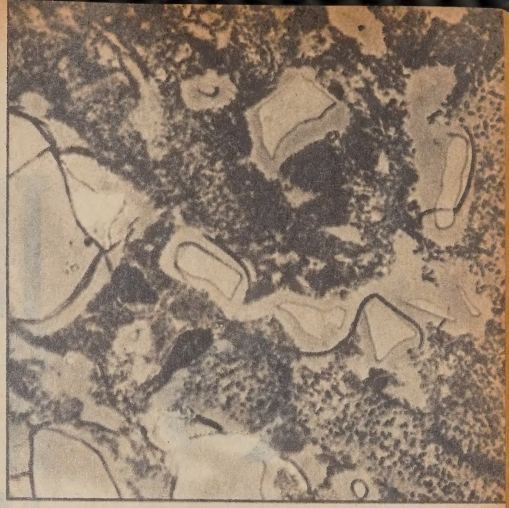


Fig. 1. STRUCTURE of typical clay-base ceramic.

NEW SCIENCE OF CERAMICS

By Dr. Joseph E. Burke*

To control the properties of these materials with the required precision, it is necessary to understand the chemical and structural variations responsible for changes in properties and behaviour. The research approach used in the new ceramics parallels that of physical metallurgy, and has led to the name physical ceramics.

Research on structure is carried on at both the atomic and microscopic level. Chemical research is aimed particularly at understanding the important structure-controlling reactions that may occur during processing.

The extreme precision necessary to control the properties of even the simpler materials is illustrated by studies made by S. P. Mitoff of the General Electric Research Laboratory on the electrical conductivity of magnesium oxide at elevated temperatures. It was found, more or less as expected, that the conductivity increased when the material was heated in a strongly reducing atmosphere to produce an oxygen deficiency.

SLIGHT IRON CONTAMINATION

This effect was not very pronounced in high-purity magnesium oxide, but addition of a few parts per million of iron contamination greatly increased the oxygen pressure dependence of conductivity. It is probable that similar and even more complicated interactions exist between purity, structure, and properties in most ceramics.

The major part of classical ceramics is built upon the truly remarkable properties of clay-water mixtures. The rheology and colloid chemistry of such mixtures have been important fields of study. When clay-base ceramics are fired, the silicates decompose and form a glassy phase which bonds the remaining crystals together. A typical microstructure of such a material is shown in Figure 1. Until recently almost all ceramics had this same general structure, with at least a small amount of a glassy phase bonding the crystalline phase.

In contrast, most of the newer ceramics are single-phase chemical compounds, either pure, slightly doped, or in some cases, such as the magnetic ferrites mentioned earlier, very heavily alloyed. A typical microstructure is shown in Figure 2. They are made from powders by sintering — heating at a temperature below the melting-point. The molecular movements necessary to attain reasonably high density during sintering occur entirely by solid-state diffusion. This is identical with the process that occurs in powdered metals.

Progress in the understanding of sintering has been rapid in recent years and much of this new understanding has come from the study of ceramics. They have an advantage over metals in such studies because, by using suitable optical techniques, changes in structure during sintering can be observed below the polished surface.

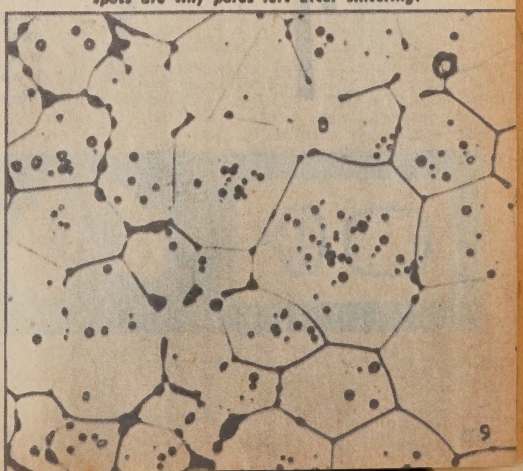
The removal of pores formed during compaction of the powdered raw material is of great importance to the density and other properties of a ceramic.

GRAIN BOUNDARIES

One of the important recent advances has been recognition of the role of grain boundaries, which act as the source for atoms which diffuse to fill pores and as sites of the shrinkage which accompanies pore filling. Studies of the sintering process have led to the conclusion that the attainment of higher density requires, among other controls, the restriction of grain boundary movement to keep the pore-boundary distances small. This facilitates the diffusion of atoms from the grain boundaries to fill pores.

The process of grain boundary movement in metals

Fig. 2 NEWER CERAMICS usually have single phase, polycrystalline structure similar to that of metals. Dark spots are tiny pores left after sintering.

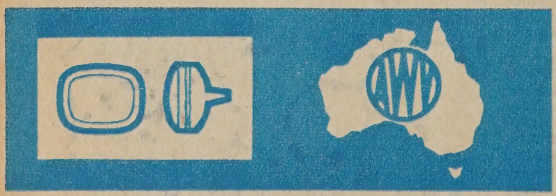


* Manager, Ceramic Studies Section, General Electric Metallurgy and Ceramics Department.

THE MAN SAID REPLACE IT WITH A NEW Super RADIOTRON PICTURE TUBE

I'm a housewife, and, contrary to what my husband thinks, I'm busy for the best part of the day. Even when the TV set is turned on I still have my work to do. For that reason the thing I disliked about our old picture tube was the length of time it took to warm up, a big part of my time was spent waiting for a picture to appear (even more annoying when the sound arrived ages before the picture did).

Now that we have to get a new picture tube, I told the Serviceman that I wanted the one with the shortest possible warm-up time. The Serviceman said that the one tube on the market with a warm-up time of less than a quarter of a minute was, in his opinion, the most reliable one, and was just what I wanted. Well, naturally, I said, "yes!" So the man said, *"Replace it with a Super Radiotron Picture Tube."*



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is well understood. This knowledge provided a good starting point in trying to learn how to control grain growth in ceramics. The key to grain growth control in aluminium oxide sintering was discovered by R. L. Coble, who used this discovery and others he made to produce "Lucalox" alumina—a completely porefree alumina oxide ceramic. The strikingly different properties of this material are in part a result of the relatively simple structural change of pore elimination.

The substance known as pyrolitic graphite is another example of a material in which a drastic change in properties results from a change in microscopic structure (see page 4). Its high density and strength compared to conventional graphite and its highly anisotropic nature are extremely useful properties in certain applications.

One of the most glamorous areas of ceramics research is concerned with mechanical properties, including studies of plastic deformation and fracture mechanisms. The glamour is associated with the hope that brittleness can be overcome to such an extent that ceramics can replace metals in certain engineering applications.

In common with metals, small perfect crystals called "whiskers" of oxides can be grown. These have very high strengths. Thin, blade-like aluminum oxide whiskers,

Fig. 4. PLASTIC FLOW of glass is shown by indentations made in hardness test. Crack between the dents resulted from subsequent corrosion by vapor.

such as those shown in Figure 3, have a strength, as determined by S. S. Brenner, of aproximately one million pounds per square inch.

It is also well known that certain carefully treated glass fibres have strengths of several hundred thousand psi. Recent observations by W. Hillig of the General Electric Laboratory have indicated that it is possible to achieve these high strengths relatively easily in silica glass rods of much larger diameter than the metal or oxide whiskers—of the order of one or two millimeters.

SURFACE DAMAGE

The only requirement is that damage to the surface must be prevented, since this produces stress-raising cracks.

Aside from these special cases, most ceramics can be divided into three classes based on their ability to undergo plastic deformation:

1. Those that will not deform plastically under any conditions.
2. Those that will deform only at elevated temperatures.
3. Those that undergo plastic deformation at room temperature, more or less like a metal.

Under most conditions of testing, it appears that quartz is a representative of class 1. No gross plastic deformation has been produced in it, even using high hydrostatic pressures to prevent cracking.

Probably the majority of nonmetallic materials may be deformed plastically only when hot, and thus fall into class 2. This behavior implies that the stress required to fracture these materials is so low compared with the flow stress that they break rather than deform at room temperatures. At higher temperatures, the flow stress is lower and plastic

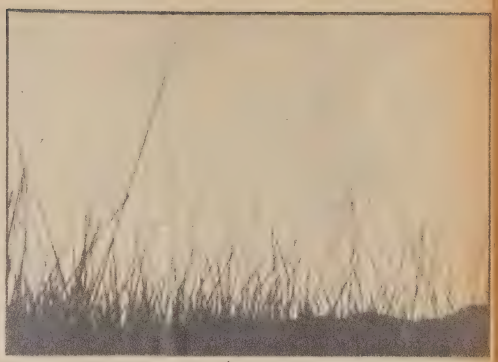


Fig. 3. WHISKERS of aluminium oxide are single crystals almost completely free of defects, with strengths of approximately one million pounds per sq. in.

deformation can occur. The glasses are in this class. At high temperatures they flow in a viscous fashion like other liquids, but at low temperatures the viscosity becomes so high that they undergo brittle fracture.

It is possible to deform glass under a hardness indenter, as shown in Figure 4. The crack between the two indentations appeared about five minutes after indentation and illustrates another important propery of glass. The stress it will support decreases with time, because stress increases the rate of attack on the glass surface by water vapor. Since there is a residual stress around the indentation, the water-vapor attack causes small surface imperfections to develop into minute cracks, which penetrate until the stress concentration is so great that fracture occurs.

Exacly the same process operates in all commercial glasses, so there is a close relationship between corrosion resistance and strength.

There is a second group of nonmetallic materials in class 2 which is typified by sapphire, a single crystal of aluminum oxide. In this group, deformation occurs by movements of dislocations within the crystal structure rather than by viscous flow. As in viscous flow, however, the flow stress increases rapidly with increasing strain rate and decreasing temperature.

QUALITATIVE EXPLANATION

A qualitative explanation of this behavior results from an understanding of the atom movements necessary for movement of a dislocation. In aluminum oxide the process has been called "synchro-shear" by M. L. Kronberg. It involves movement of aluminium ions with respect to all the neighboring oxygen atoms. The process is quite similar to diffusion and should be facilitated by high temperatures.

The class 3 materials, which undergo some plastic deformation at room temperature, are typified by the alkali halides and some oxides, such as magnesium oxide, which have the same simple cubic structure as the alkali halides. In these materials, the flow stress is much more nearly independent of temperature than it is in aluminum oxide and the strain rate does not seriously affect the flow stress.

The deformation process resembles much more closely that which occurs in metals. This is not to say that they are readily deformed. At room temperature, fracture occurs if the greatest care is not taken to prepare the specimen. At higher temperatures, when the material is somewhat softer, more severe bending is posible. Extensive investigation of the atomic mechanism by which these slightly ductile materials deform is being carried out by, among others, the Laboratory's W. G. Johnston.

From this short discussion, it should be apparent that ceramics offers many opportunities for fruitful research. The greatest need is for precise measurements of the behavior of carefully characterised materials since, as has already been pointed out, small changes in composition or structure can produce striking changes in properties.

An increasing number of measurements are being made of chemical diffusion coefficients, electrical conductivity, dislocation mobility, magnetic structure, and other properties. Out of these measurements will come, we are confident, the understanding which will permit development of many exciting new materials.

The Chemistry of Fireworks

Quite innocently, one of our staff, a photographic enthusiast, remarked "that's a cracker shot." We agree completely. It is a cracker shot!

by Calvin Walters

There is a fair chance that most of our readers will be involved, during the month, in cracker night festivities. Since these same festivities will cost you a fair amount of money, you may as well know what you are getting for it!

SOME TIME during the reign of William III of England between the years 1689 and 1702, the following enactment was placed upon the Statute Book of the English Parliament:—

"If any Person shall make or cause to be made, or sell, give, or utter, or offer, or expose to sale any Squibs, Rockets, Serpents, or other Fireworks, he shall forfeit Five Pounds. And that if any Person shall permit the same to be fired from his House . . . or shall cast or fire, or aid in casting or firing the same in any public street, House, Shop, River or Highway, he shall forfeit Twenty Shillings, or be committed to the House of Correction to Hard Labour for one Month."

There is no doubt that this enactment still stands on the Statute Book, together with many other outdated ones. Should, however, any Government of today attempt to enforce such a law, there would be mass meetings of small boys all over the country demanding satisfaction for interfering with their amusement. No doubt many adults would also take a hand in the protests, the result being the defeat of the Government at the next elections.

So it is that, with complete freedom to fire or expose for sale any Squibs, Rockets, Serpents or other Fireworks, the night of May 24 each year is one to be remembered by every inhabitant of the Commonwealth.

DAD LETS THEM OFF

It is a night of delight for small children who can watch their "crackers" being let off by dad, who can always show them the best way to handle things. It is a night of hard work for Fire Brigades and Police and a night of terror for every dog in the district whose ears, unable to stand the din of explosions, seek safety in far away places, resulting in congestion at the dogs' home the following day.

The folowing dawn exposes a scene of desolation, with vast quantities of debris littering the parks, highways and gardens. Letter boxes blown apart and motorists carefully feeling their way through the dense smog hanging low on the roads from the fires of the night before.

Ferry services and railway timetables are disorganised, thousands of pounds have gone up in smoke yet every one is happy. Nevertheless dad says "no more money to be wasted that way," knowing full well that it will be the same next year and the year after, with himself as keen as any small boy for "cracker night" to come round again.

The art of making fireworks dates back into antiquity. Nobody seems to know when it all started and by whom. It is generally conceded that it began in the East either China or India. It is also known that fireworks were used long before the invention of gunpowder.

There are ancient writings such as those of Philostratus between the years 170 to 250 A.D. which refer to what must have been explosive devices used by some towns to defend themselves against Alexander the Great in B.C. 326.

The word fireworks denotes the actual device and firework display means the arranging of the devices in planned order to give a display.

The more correct terms to use are Pyrotechny as the art of firework making, Pyrotechnical display which is self explanatory and Pyrotechnist as the person responsible for the arranging of the planned display. Letting off bungers and so on on cracker night is not a display. It is a sheer explosive confusion.

Most probably, the combustible firework material first noticed by man was saltpetre or nitrate of potash, which is a natural substance found in large quantities in Eastern countries such as India and China. This was used in those days for "salting" meat and other culinary purposes.

Most school children who have learned some elementary chemistry have carried out the experiment of soaking a piece of blotting paper in a solution of saltpetre. When dry and ignited the paper burns with a sizzling sound. It is one of the ingredients of the "touch paper" at the end of some fireworks such as Roman Candles and Sky Rockets. Its main purpose here is to provide a safe way to light the wick.

AN ARTIST IN FIREWORKS

The Pyrotechnist is an artist in the same way as a painter, a decorator, a landscape gardener or a window dresser. He must be well versed in arranging the many devices at his command, so as to bring about the most spectacular result.

If you carefully observe a pyrotechnic display you will notice that there is usually a definite order in the firing of the various devices.

It usually commences with the firing of rockets then gradually working up through coloured fire devices to the explosive variety. There is nothing more psychologically unsound than to commence a display with a roar of explosive devices thus frightening the spectators to a point of nervous tension.

In certain countries, notably China, fireworks are extensively used in certain ceremonial rituals such as weddings or funerals, both of which are usually accompanied by considerable noise.

In China there is a type of "class distinction" in the use of colours of fireworks, so that the upper classes use yellow, the public use red and the legal and police use green. At least that's how it used to be a few years ago. With the change of government these distinctions probably have been abolished or modified. Maybe red is now the colour for everyone.

In early times, many superstitions surrounded the manufacture of firework compounds and certain precautions were necessary in order that no accidents should occur and that the compounds should turn out just right.

For instance, the early Chinese believed that if firework mixtures were made in a house where a man had died, there was bound to be an explosion. This especially applied to a house where the occupants were mourning the loss of a member of the family.

However, if the family were mourning the loss of someone who was not a member, then all that was necessary was to hang a piece of red silk in the house and an explosion would not occur.

There were restrictions on the packing of powder by women. If this was done by women, the character of the fireworks would be all mucked up so that, when you lit a cracker you would find it was a serpent or a fountain and so on.

CURE FOR A HANGOVER

Some people let off crackers for their health, the most outstanding example being the firing of jumping crackers to cure a hangover after a night out.

Pyrotechnic displays are today used to celebrate great occasions and, because of the great advance in manufacture and technique, very wonderful results are attained and at great expense.

The most important ingredient of a firework is, of course, the charging powder. These are somewhat in the nature of gunpowders. By this I mean that they consist of substances which are combustible and substances which supply oxygen for their rapid combustion.

Charcoal and sulphur are combustible substances which burn very slowly in air.

If, however, they are supplied with an abundance of oxygen they burn with greater rapidity. It is obviously impossible to have an oxygen tank in every cracker so some other means must be found to supply the required amount of oxygen to the charcoal and sulphur.

There are chemicals which supply oxygen when ignited and mixed with carbon. These are Potassium Chlorate, Potassium nitrate (saltpetre), sodium nitrate, barium nitrate, potassium perchlorate and a few others.

The combustible substances which are used include carbon in the form of charcoal, flour, asphalt, resin, shellac, sugar, stearin, milk sugar and certain gums. Sulphur is used in the mixture because it increases the affinity of the constituents for one another and generates greater heat.

The dextrin also provides the glue for holding the composition together for, in the making of a star, the composition must be dampened, compressed, dried and cut to shape.

There are "cut stars" which are merely slabs of the compressed composition cut to cubes. There are "box stars" consisting of little paper containers filled with the composition and "pump stars" which are made by compressing the damp mixture in a small cylinder by means of a plunger.

From the point of view of popularity the Roman Candle is probably at the top of the list. A brief description of what these involve may be of interest to the firework enthusiast.

RATE OF BURNING

One of the main properties of many firework compositions is the ability to burn fairly slowly and not explode in one burst. Thus nitroglycerine and other such explosives are not desirable items in the art of the pyrotechnist.

Careful selection of the composition controls the rate of burning so that any desired effect can be obtained.

Colours are, of course, an important feature in the production of fireworks. These are obtained by mixing certain metallic salts with the firing composition.

For blue flames salts of copper are used, such as copper carbonate, copper sulphate, copper sulphide, copper black oxide, and so on.

For green flames the salts of barium are used. These include barium nitrate, barium chloride. Red is given by salts of strontium such as strontium nitrate and strontium carbonate. Pink is produced by salts of calcium including calcium carbonate, calcium sulphate and calcium oxalate.

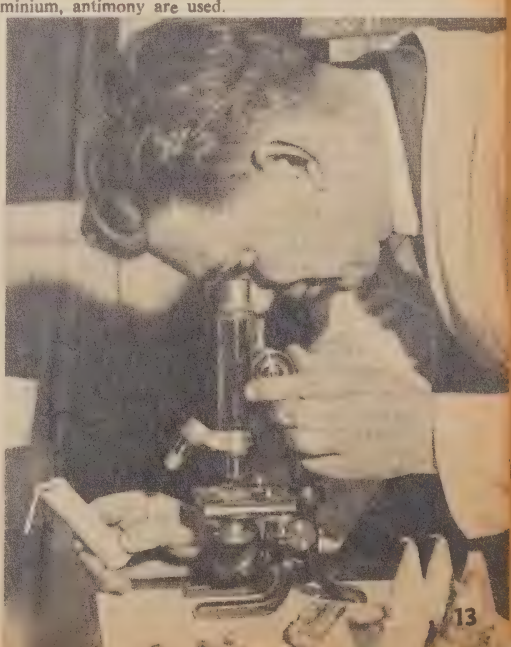
Sydney Harbour and foreshores, lit up by a spectacular display of coloured fireworks.

Sodium is extensively used to produce yellow colours. For this the salts of sodium are sodium nitrate, bicarbonate, perchlorate oxalate and metantimonate.

Combinations of strontium and sodium salts are used to produce purple flames.

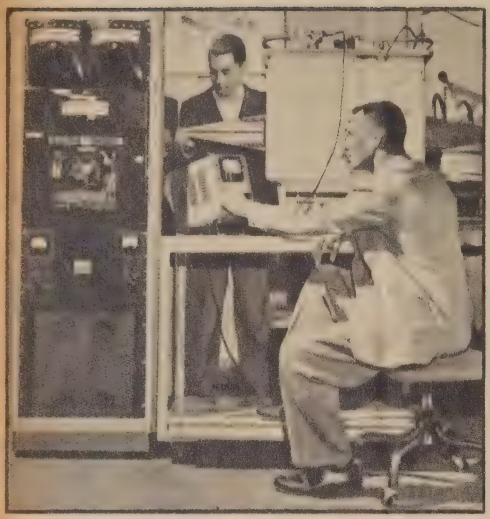
All sorts of materials find a use in pyrotechny and metal filings plays a very important part in producing special effects.

In the production of sparks and brilliant white fire such metal filings or powders as magnesium, iron, zinc, aluminium, antimony are used.



Last May, there were complaints that fireworks on sale to children contained more than a "safe" quantity of explosive. The picture shows crackers being examined by an analyst of the N.S.W. Mines Dept.

TESTS RADOME COVERS



A HIGHLY accurate resonant cavity X-band dielectrometer for measuring electrical behaviour of radomes and antenna covering materials at temperatures to 2,700 degrees F. has been developed by research engineers at the Boeing Aero-Space Division in Seattle. The new device measures dielectric constant to within 1 per cent. It also measures loss tangent.

Based on earlier instruments developed at Boeing, the new dielectrometer will speed laboratory development of new dielectrics — materials with special electrically transparent qualities — for radomes and antenna windows capable of withstanding the higher temperatures of hypersonic flight. Temperature limits for continuous exposure of today's refractory dielectrics without serious electrical degradation are generally in the neighbourhood of 1,500 degrees F.

Design of the device is based on the long known but little used resonant cavity technique which Boeing engineers say is more accurate at high temperatures than conventional shorted waveguide methods. For a fixed excitation frequency, the change in length required to return the variable length cylindrical cavity to resonance after inserting a material test sample is the measure of the sample's dielectric constant. Change in cavity "Q" produced by the sample is used to calculate its loss tangent.

The device measures 24 by 21 by 13 inches, not including Boeing-assembled console. Integral heating also is provided for pre-heating up to 12 material samples in a holder adjoining the test cavity. A transfer chute connects sample holder with test cavity.

Photo shows dielectrometer mounted on table with control console (left) and Boeing physicists Robert W. Sutton and Nestor Grechny jun., designers.

Probably the most important division of the making of fireworks is the manufacture of stars. These produce the beautiful effects both on the ground and when produced in the air from rockets.

A typical formula for making say a red star is as follows: Dextrin 1 part, strontium nitrate 12 parts, shellac 2 parts, potassium chlorate 12 parts, powdered charcoal 4 parts. In this mixture the burning materials are the charcoal, shellac and dextrin. The oxygen producing component is the potassium chlorate while the colour is provided by the strontium nitrate.

Strong paper tubes are first blocked off at one end by means of wet clay. This is of course allowed to dry out so that it will not be blown out by the composition.

A typical composition for the burning mixture is Saltpetre 18 parts, fine charcoal, 11 parts, powdered sulphur 6 parts and dextrin 1 part. This is thoroughly sieved and mixed with about a gallon of water, mixed again, forced through a fine sieve and dried out in the sun.

A small quantity of this mixture (about a dessert spoon full) is poured into the tube followed by a star and another quantity of composition. This is rammed lightly. This is repeated until the tube is full of alternate layers of composition and stars, to about two inches from the top.

Into the top layer of composition a "match" is inserted This is concealed in the twisted piece of paper found at the end of a Roman Candle or rocket. The making of a "match" or "wick" will be described in a moment.

When the match is lighted it ignites the top layer of composition which fizzes out the end until exhausted. The final bit of powder ignites the star which is ejected out like a miniature bomb. This also ignites the next layer of composition and so the process goes on.

RESPONSIBLE FOR "DUDS"

Matches or "wicks," as they are commonly called in this country, are the most important item from the point of view of the success of a complex display. Bad wicks are responsible for most "duds" on cracker night.

Match wick, as we will call them, consist of cotton wick thoroughly impregnated with gun powder and wrapped in thin loose paper tubing. The difference between a fuse as used in blasting operations and the match wick used in pyrotechnics is that fuse burns at a rate of approximately one inch in three or four seconds whilst the match wick is almost instantaneous.

The rate of burning must of course be controlled by the mixture so that safety precautions may be taken in accordance with the size of the firework. Very large fireworks need a slower burning wick to allow for quick get-away of the operator.

Sky rockets are a very popular type of firework and rank next to Roman Candles in this respect. Sky rockets must be made with some precision regarding uniformity and balance so that they will ascend properly, and so that a battery of rockets in a display will all ascend to the same height and explode at the same time.

Basically a rocket consists of a tube with the lower end choked off to one third of the diameter. The composition with which it is filled has a hollow centre to about two thirds of its length. This is to allow the fuel to burn more readily. The remaining solid portion at the top acts as a fuse to ignite the stars, crackers and other spectacular gadgets in the top or nose of the cone of the rocket.

All sorts of contrivances can be held in the cone which can explode and release the contents when required.

The composition of the mixture is merely one of saltpetre, fine carbon and sulphur. In other words gunpowder. Powdered coal is usually used for the carbon content in rockets. On the proportions of coal to saltpetre depends the speed of ascent of the rocket. The principle of the ascent of a sky rocket is exactly the same as for present day space and ballistics missiles. It is interesting to note that the rocket is probably the most ancient type of firework known to man.

CONTROL OF FLIGHT

A sky rocket is balanced in flight by means of the stick attached to it. Other means such as vanes on the side are used in the more complex types such as military rockets.

The purpose of chocking the end of the rocket case is to allow a gradual escape of burning gas. Without the choke the rocket would merely explode and refuse to ascend.

An interesting firework is that known as "Pharaoh's Serpents" and is also a popular item on cracker night. This device depends on the remarkable property of sulphocyanide of mercury of swelling to about 50 times its

(Continued on Page 109)

Word of Warning:

Calvin Walters presents the information in this article as a matter of topical interest. If you are ever tempted to experiment, remember that explosive mixtures can be dangerous, particularly in quantities.

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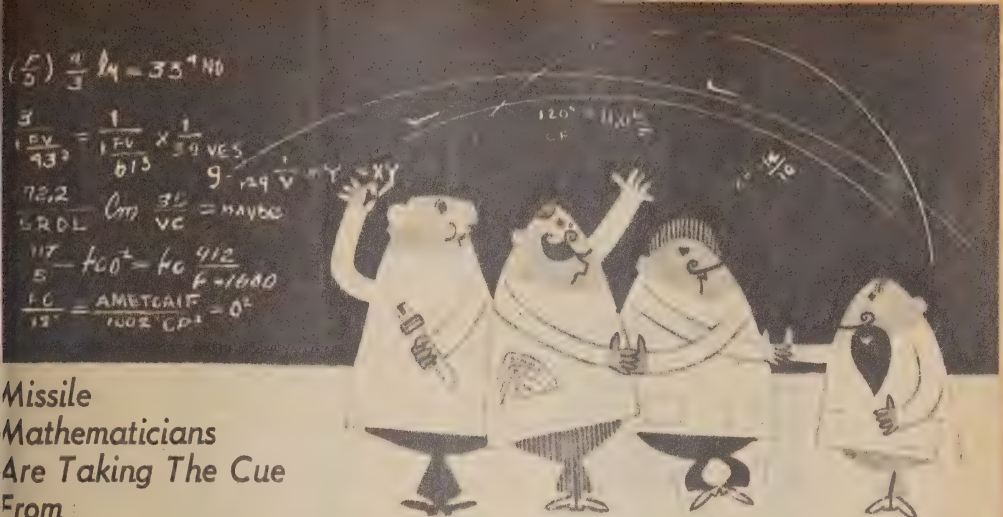


Missile Mathematicians Are Taking The Cue From

GAMBLER'S LAW

A branch of mathematics which has been used as a guide by bomber pilots and riverboat gamblers alike is playing a strong supporting role in the development of modern missiles. It concerns the laws of probability—the laws which help predict how many times a tossed coin will come up heads.

By William Jury

DURING World War II, application of probability theory to bombing actics helped pilots pick the way of least esistance through enemy flak.

Gamblers use the laws of probability o establish odds and rates of payoff in asinos and gaming houses throughout he world.

Probability theory is also involved in he design of modern missiles such as he Bomarc Pilotless Interceptor, being roduced in the U.S. by the Boeing Comany.

CHANCES OF SUCCESS?

When devices were being designed for omarc to help keep it on target, deite evasive actions of the enemy, enineers wanted to know what were the hances of success if every conceivable ffort were made by the target aircraft o avoid the intercepting missile.

A solution was worked out in much he same way that life insurance rate ables are established—by working with ast quantities of statistics and the laws f probability.

Most of the formulas used to solve omarc problems were classical, garden ariety types known to mathematicians or years. Others were created on the pot to meet requirements peculiar to he missile age.

The target homing instinct of Bomarc based on electronic impulses sent out om the missile. When these impulses etect a target, the missile follows their nstructions into a collision course, which ould spell finis for the target at the oint of impact.

The missile does not have an all-diserning eye, however, and a flash of ightning in some instances could "look" ie same as an enemy bomber.

How often should a missile ignore the signal before deciding it is the real thing, mathematicians were asked. Once? Twice? Three times? The answer—provided by the laws of probability—is carried in one of the little black boxes which make up the electronic innards of Bomarc.

Although the missile's design is influenced by the same mathematical theories which guide gambling casino operators today, Bomarc's integrity is not a matter of chance. The pilotless interceptor can cover effectively an area of up to 500,000 square miles and knock down supersonic targets from sea level to extreme altitudes.

Gamblers provided the impetus for the first serious study of the laws of probability. Two centuries ago it was apparent that the turn of a card or the spin of a roulette wheel was guided by something more than Lady Luck. Gamblers and casino operators with money to spend for a method of calculating the odds on various games of chance sought the answers to their questions from mathematicians.

Entry of the aircraft industry into the age of missiles and rockets also brought problems that required special skill in mathematics. Space flight, for example, posed a challenge to invent navigational techniques far more complex than those that guided airplanes. Mathematicians were better qualified than engineers to produce many of the answers needed.

Boeing some time ago established an organisation called the mathematical services unit. It is staffed with mathematicians selected for "unusual competence and training in mathematical areas of recognised importance and application to company problems, present and future." Bomarc is just one of the areas of interest.

TEAM OF MATHEMATICIANS

Information developed in the research laboratories is made available to the engineering departments of the company.

Today, Boeing has approximately 400 mathematicians on its payroll, slightly more than the number of physicists in the company. They are working in such areas as probability and statistics, mathematical theories of fluid mechanics, the mechanics of solids, electromagnetic theory, heat transfer, dynamics, noise, and information theory and mathematical economics. Other fields include numerical analysis, logic of computer design, and theory of games.

For all their experience, however, none of the mathematicians, as far as is known, shares the belief of some less informed mortals that there is a probability of beating the odds at Las Vegas.

LONDON'S 500ft RADIO TOWER

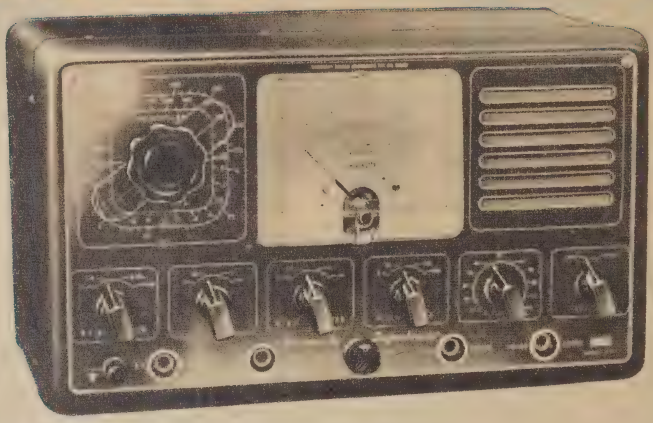
PLANS to erect the tallest building in London, a 500ft tower to carry micro-wave radio and television links, were announced by the British Postmaster General, Mr Reginald Bevine.

He said the project, estimated to cost about £stg1¼ million, was designed to obviate the risk of obstruction to television links and public telephone services from existing buildings or those planned. More and more trunk telephone traffic was being carried by radio instead of by underground cables, and the site of the tower, alongside the extension to the Museum exchange, was also a focal point for micro-wave radio links, which required a clear "line of sight" from point to point.

Believing that the new tower would add to London's amenities the Post Office was providing a public observation platform at 450ft. The scheme would be started this year and it was hoped it would come into operation in mid-1964.

UNIVERSITY INSTRUMENTS

SUPERTRACER



MODEL AST

Here is the best labour-saver and profit-maker a radio workshop can have. It is a modern and highly efficient signal tracer and fault finding is speedy and easy with the new instrument. Convenient to use, it will give new speed to the detection of faults in radio receivers and similar equipment. One of the worst features in a faulty radio receiver is intermittent operation.

Now you can easily find it with this new supertracer. Lack of sensitivity, radio frequency oscillation, audio oscillation, distortion, hum and a host of other faults can quickly be pinned down with the model AST. The instrument, measuring 14½ in. long by 9¾ in. high and 8¼ in. deep, has a black and silver anodised front panel. Here is an instrument you cannot afford to be without.

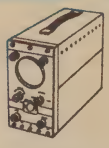
OTHER INSTRUMENTS IN THE COMPREHENSIVE "UNIVERSITY" RANGE

RESISTANCE CAPACITY TESTER—MODEL UBA

This instrument is designed for the measurement of an extensive range of resistances from 0.1 ohm to 10 megohms and capacities from 10 *µµ*F to 10 *µ*F. The UBA is sensitive and OVERLOAD PROOF.

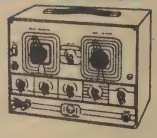
ELECTRONIC VOLTOHMETER —TVR/EV

This smartly styled, large-scale Electronic Voltmeter, although designed especially for servicing television receivers, will also test and align A.M. or F.M. receivers, measuring AVC grid bias and screen grid voltage in high-impedance circuits.



OSCILLOSCOPE—MODEL—TVR/C3

This small portable Cathode Ray Oscilloscope will be found invaluable for TV and radio service work and is extremely handy for all tests. Industrial users, too, will find many profitable uses for this lightweight instrument.



TELEVISION ALIGNMENT GENERATOR—TVR/SM

This University instrument is the ideal signal source for precision alignment of TV and F.M. receivers. Model S.M. combines both a precision marker generator and sweep oscillator in one convenient metal case.

UNIVERSITY
GRAHAM
INSTRUMENTS
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TV Servicemen and Service Organisations are invited to inspect the Television and Radio Test Equipment under working conditions in University's special demonstration room.

5 NORTH YORK STREET, SYDNEY
TELEPHONE BU 3169

Technical Review

NEW UNDERWATER TV CAMERA FOR TURBID WATERS

A recent invention of the well known French undersea research worker, Commandant Cousteau, promises to simplify the problem of under water television in turbid waters. The solution to the problem is notable for its simplicity.

THE possibility of using television cameras to investigate underwater situations has long been appreciated, the first practical use being in 1951. This was on the occasion of the tragic loss of the British submarine Affray, which sank in the English Channel in 256 feet of water.

A score of wrecks in the area were pinpointed by Asdic, and each one examined with an underwater TV camera for identification. After two months' searching those on board the Reclaim were rewarded when the name Affray appeared dramatically on the monitor screen.

The identification of the Comet airliner lost in the Mediterranean in January, 1954, was the second major feat of undersea television.

UNFAVOURABLE CONDITIONS

However, conditions do not always favour the use of TV cameras. In many cases the water is too dirty to permit useful observations to be made at useful distances or depths. For example, even in the clear waters of the Mediterranean, visibility ceases at depths below about 65 feet, while in the Atlantic it is reduced to a few yards. In Paris the turbidity of the Seine is such that during a large part of the year the light of a torch can hardly be seen at a distance of about six inches.

Water—already absorbing light itself—contains numerous particles in suspension acting like mist in the air; stopping the light reflected by objects as well as that meant to light them. The light is rendered diffused as each particle reflects the beams in different directions.

In these circumstances, seeing through the water of the sea, of a port, or of a river belonged to the realm of dreams.

Today, thanks to television, the dream has come true and a man at the surface follows what the camera sees in these invisible depths.

Until now, with the exception of the few yards gained by the use of the caulk goggle, engineers had to trust completely to the skill of the diver and any control of underwater work was impossible.

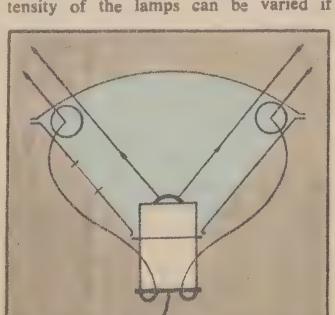
A recent French invention promises to overcome many of the problems of underwater visibility.

Commandant Cousteau, known throughout the world for his undersea research work, conceived the idea of

The new TV unit in use. The camera proper is a water-proof unit mounted at the rear of the cone-like housing, the latter filled with clear water. Note the high powered lamps on either side and the power cables entering at the top.

placing in front of the lens a body of clear water which takes the place of the muddy water. This pushes back the misty zone to the limit of the device. The "clear water cone" thus achieved is the frustrum of a pyramid made from plastic, the clear plexiglass side of which is applied to the object.

Lighting is provided by two 1KW reflecting lamps, placed inside the clear-water cone, near the front and outside the limit of the field of the lens. Thus they are favourably located with respect to the object, while the side lighting they provide can be used to advantage to stress the relief of the object. The intensity of the lamps can be varied if required.



Plan view of the new system, showing the camera proper at rear, the plastic cone filled with clear water, and the two lamps near the face of the cone.

The clarity of the image thus achieved, and aided by the controlled lighting, is made still more useful by the use of a special wide-angle camera lens. This gives an angle of vision of 80 degrees, compared with the usual 50 degrees found in the average camera.

When the camera is being guided by a diver, the engineer on the surface watches the picture on the screen and directs the diver through a loudspeaker.

The loudspeaker is mounted in the waterproof camera case. Because the transmission of sound through water is better than through air, the diver can hear clearly at distances up to 16 feet from the camera. The loudspeaker may also be switched on to work as a microphone, allowing the diver to reply.

However, the equipment does not always require divers for its utilisation. Many jobs, such as periodical checking of those things threatened by the weathering action of water—sluice gates, bridge pylons, piers, etc.—can be performed by simply lowering the camera into the water and moving it into position from above. A visual check by this method is much more valuable than any diver's report.

The perfection of this equipment is the joint work of two French firms and the French Underwater Research Agency, whose chairman is Commandant Cousteau.

(From "French Economical and Technical Bulletin.")

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No need to wait for the equipment you need for testing, amateur radio, stereo or marine! The world's finest imported electronic equipment can be yours to enjoy NOW—for only a small deposit and easy weekly repayments from Warburton Franki who invite you to send for full details of the HEATHKIT Easy Payment Plan. Described here are just a few of the hundreds of Heathkit units available in cost-saving, easy-to-assemble form from your nearest W.F. Office.

Versatile Audio Generator

HEATHKIT AG-9A AUDIO GENERATOR KIT

No well equipped audio lab or service shop should be without this versatile instrument. The AG-9A produces near perfect sine waves for a multitude of audio testing applications. Use it as a signal source for bridge measurements, harmonic distortion measurements, external modulation of r.f. signal generators, or testing audio amplifiers for gain and frequency response.

Specifications: Frequency, 10 c.p.c to 100 kc., switch selected, two significant figures and multiplier. Output: 6 ranges 0 to 0.003, 0.03, 0.1, 0.3, 1 volt r.m.s into external 600 ohm load or with internal load into Hi-Z. Two ranges 0 to 3, 10 volts r.m.s into a minimum of 10,000 ohms, minus 60 db, to plus or minus 22 db, in eight steps, minus 60 db to plus or minus 2 dbm. (0 dbm1 equals mw. to 600 ohms).

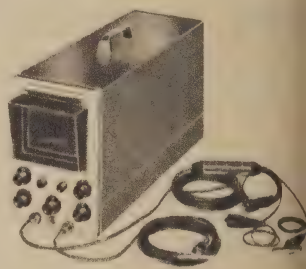
Distortion: Less than 0.1% 20 to 20,000 c.p.s.

Wgt. 10 lb. Size: 9½ x 6½ x 5in.

PRICE £50/1/-

Just what every home mechanic needs!

A LOW COST ELECTRONIC IGNITION ANALYSER



Available in kit form (1A-1A) and wired form (W-1A-1A).

This versatile unit checks ignition system of any automobile while in action, thus spotting weaknesses without need for removing individual components. Simple to use, with a minimum of controls, the Analyzer is completely flexible for use on all types of internal combustion engines with coil ignition and accessible breaker points. Can even be used when car is in motion and under load. Will display complete cycle or just one cyl. at a time. To check the complete ignition system of car in operation, just plug in and clip on test cable leads: the display on the screen makes it possible to determine condition of coil, condenser, points, plugs and ignition wiring. A switch selects either primary or secondary circuit patterns: or alternately, provides choice of "parade" or "superimposed" secondary patterns. Also detects breaker point bounce and facilitates checking of point dwell-angle setting. RPM range 400-5000. Operates from 105-125 V.A.C., 50/60 cycles. Size 6½in x 11in x 20in.

Price £72/16/- (Kit Form), £106 (Wired

Versatile, easy-to-use tube checker kit

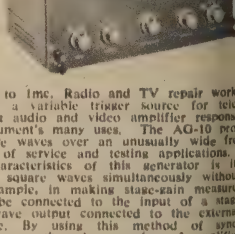
HEATHKIT TC-3

No modern service shop would be without it! Will check all types normally encountered; provides for new types as developed. Flexibility of operation possible through multiple filament voltages, adjustable cathode current, variable meter sensitivity and individual element switching. 10-lever switch permits connecting any element to any other element regardless of pin numbers involved. Test tubes for quality on basis of total emission, for shorts, leakage, open element and filament continuity. Read quality on multi-coloured meter scale; neon bulb indicator shows filament circuit continuity and leakage of shorts between elements. Both roll chart and meter illuminated. Operates from 105-125v A.C., 50/60 cycles. Weight 12lb Size: 5½in x 8½in x 13in.

PRICE £44/12/-

Two wave shapes from one instrument

HEATHKIT SINE-SQUARE GENERATOR KIT (AG-10)



Wide Frequency Range—20 cycles to 1mc. Radio and TV repair work, checking oscilloscope performance, a variable trigger source for test metering and pulse work, checking audio and video amplifier response . . . are just a few of this instrument's many uses. The AG-10 produces high quality sine and square waves over an unusually wide frequency range for a great variety of service and testing applications. One of the most remarkable characteristics of this generator is its ability to produce both sine and square waves simultaneously without affecting either waveform. For example, in making stage-gain measurements, the sine wave output can be connected to the input of a stage to be measured and the square wave output connected to the external sync terminal of an oscilloscope. By using this method of sync measurements can be made all the way through a number of amplifier stages without having to readjust the oscilloscope synchronising control. Features include a 5-position band-switch, continually variable tuning, shielded oscillator circuit, separate step and variable output attenuator in range of 10, 1 and .1 volts for both sine and square wave with an extra range of 0.1 volt on sine wave. Operates from 105-125 V.A.C. 50/60 cycles. Wgt.: 12lb. Size: 13in x 8½in x 7in.

PRICE £55/17/

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Review—ELABORATE AUTOMATIC WEATHER STATION

The U.S. Bureau of Standards, in co-operation with the U.S. Weather Bureau, has developed a specialised digital computer for the Weather Bureau to use as a research tool in exploring the concept of automatic weather stations. It is known as Amos IV.

FOR a number of years the Weather Bureau has been appraising the possibilities of an automatic weather tation. Such stations could be widely distributed and would e especially useful in relatively inaccessible locations that re important sources of early data on meteorological ctivity. The various developmental prototypes of this con- ept have been called AMOS (Automatic Meteorological)bservation Station).

Several of the input quantities to the AMOS computers, ich as cloud height and precipitation, cannot be satisfac- orily represented by instantaneous values, but must be me-averaged. Varying amounts of data processing must herefore be associated with the different instruments measur ig these quantities.

SPECIAL COMPUTER

In AMOS IV, the automatic weather station is built round a single small, general-purpose computer designed specially for this application. The computer receives data om the input instruments at any desired interval. These ata are suitably processed and arranged in a specified order or teletype transmission in a variety of message formats nd at various speeds.

The computer continuously monitors new input data hile simultaneously processing data already entered and ansmitting messages on command. Among the input uantities which the computer AMOS IV can handle are mperature, dewpoint, wind speed and direction, atmospheric essure, precipitation, transmissivity and cloud height.

Input data can be received directly from the instruments the simplest possible forms, such as analog voltage, cur- nt, or resistance; and pulse rate or contact closure. Infor- ation may also be received in coded form, such as the ray binary code frequently used with shaft-position ncoders. The nature of the weather instruments and of ie quantities measured limits the input data to two or ree decimal digits for the most part; word size is therefore ree digits plus sign. Double-precision methods are avail- able for those few instances requiring greater accuracy.

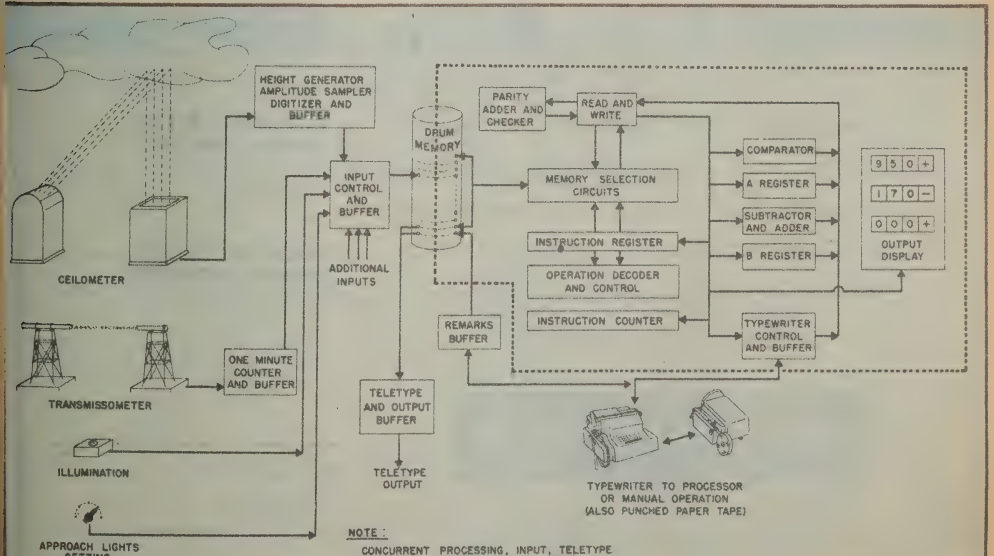
To store data, the machine uses a magnetic drum operating at 1,800 r.p.m. that carries 100 general storage channels of 100 words each and has space for 100 additional channels. Several dual-head channels are available for simultaneous read-in and read-out of incoming data, out- going messages, etc. The magnetic drum provides the exten- sive storage capacity required for the table look-up involved in the calculations of runway visual range and approach light contact height. About 35 tables are stored on the drum; each table has about 90 three-digit values.

One set of these tables contains the data on runway visual range (R.V.R.), i.e., the distance along the runway visible to a pilot from the point of touchdown—generally 1,000 to 6,500 feet, depending upon runway illumination (natural and artificial) and atmospheric conditions. The primary input for the R.V.R. determination is a trans- missometer reading. The computer continuously monitors this reading and "looks up" the proper corresponding value of R.V.R., which is then displayed locally and inserted into the teletype message.

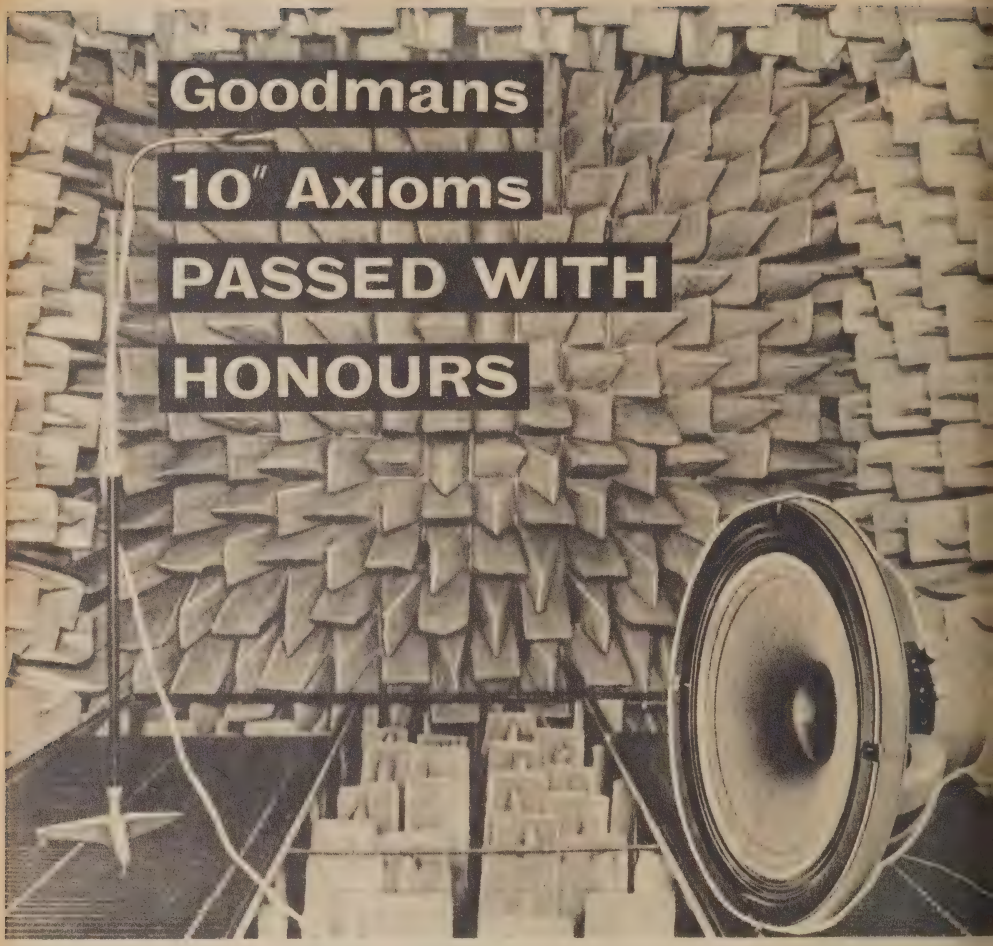
APPROACH LIGHT CONTACT HEIGHT

The other set of tables contains the data on approach light contact height (ALCH), i.e., the height from which the pilot can identify the approach lights. ALCH is affected by background illumination level, atmospheric conditions, and the intensity of the approach lights, which are set in accord- ance with prevailing conditions. If limiting conditions are indicated by either low clouds, as shown by the ceilometer, or by fog or snow, as sensed by the transmissometer, a value of ALCH based on the interfering factor is obtained.

If both factors are present, two calculations are made; the machine then determines and displays the lower value. Since there is a statistical uncertainty in this type of infor- mation, two values of altitude are presented. The higher altitude is that at which the pilot has a 20 per cent proba- bility of seeing the approach lights; the lower altitude is that at which the probability is 90 per cent.



The Amos IV computer receives data from weather sensing instruments and processes these data through such functions as sampling, comparing, selecting a maximum, and arithmetic operations.



Goodmans loudspeakers are subjected to the most severe examination in the anechoic chamber, shown above, during both development and subsequent manufacture, ensuring that your GOODMANS HIGH FIDELITY LOUDSPEAKER has "passed with honours" and that its performance will justify your choice.

AXIOM 110
Price: £9/7/6
Power Handling : ..... 10 Watts.
Flux Density : ..... 12,000 Gauss.

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Price: £15/12/6
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Flux Density : ..... 16,000 Gauss.

BOTH UNITS have a frequency range of 40-15,000 c/s and impedance of 15 ohms.

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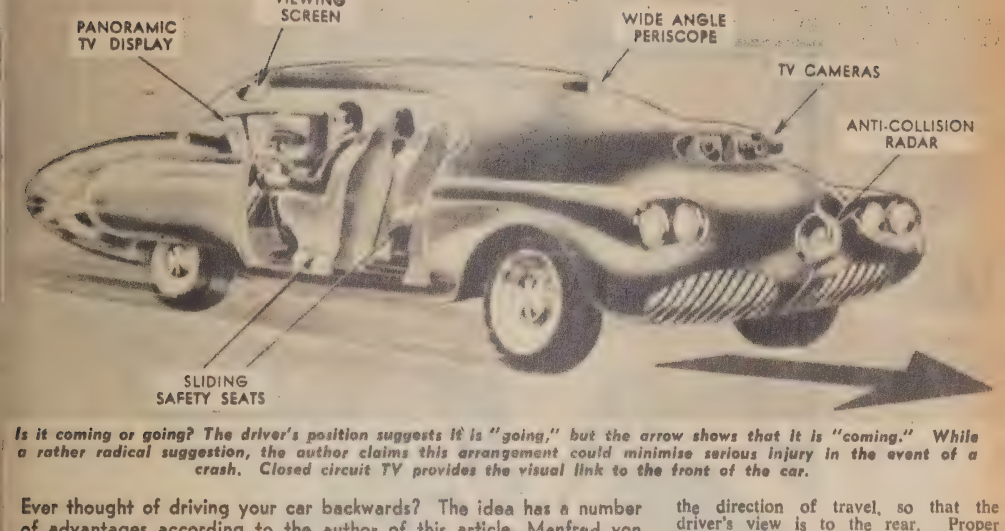
Review—'SAFETY CAR' DRIVER FACES BACKWARDS



Is it coming or going? The driver's position suggests it is "going," but the arrow shows that it is "coming." While a rather radical suggestion, the author claims this arrangement could minimise serious injury in the event of a crash. Closed circuit TV provides the visual link to the front of the car.

Ever thought of driving your car backwards? The idea has a number of advantages according to the author of this article, Manfred von Ardenne of the Manfred von Ardenne Research Institute, Germany.

A FEW months ago the world Press carried a truly sensational report: n a mid-air jet explosion the pilot was hrown clear without his parachute. Ex-:eptional luck had him wind up in a hay-tack with nothing more than a broken eg to complain about.

By this unusual occurrence nature has hown a way of solving one of the press-ng problems of our time, the design of ıigh-speed transportation with greater afety for the traveller.

There exist substances and conditions hat permit the complete deceleration of human body from speeds of several ıundred miles per hour within a yard or o, without critical injuries.

High-speed transportation should iterally carry its own "haystack" or ›raking material along for the protection ıf the traveller in an accident.

Experiments in connection with space ight have shown that deceleration in he order of 35 G can be tolerated with-ut damage. It should be noted that in hose experiments the subjects were re-ained only by belts and the seats were o oriented as to give no protection. If he seat is positioned backward with espect to the direction of travel, one an expect that the body will be suitably ›raced from head to foot. Under such onditions decelerations of up to 50 G an be tolerated for short periods with-ut more than minor injuries.

ADICAL IDEA

Recent progress in the television field ıakes it possible to consider the radical ›lution (patent applied for) shown in ıe drawing and described in the follow-ıg paragraphs:

It is quite understandable that the ılution has been suggested, not by ɔmeone in the automotive field, but by n electronics engineer closely associ-ted with the television industry.

At the present state of the art, only moderate additional development work is needed to create a panoramic (wide-angle) TV installation which permits the driver to be seated with his back to the direction of travel. A picture of exceptional clarity (1,000 lines) would show a panoramic view of the road and surrounding area, as would normally be seen from the front of a car.

Three television cameras, each with a horizontal angle of 70°, could create a picture representing a view of 210°. This picture could be presented on three picture tubes in such a manner as to cover a horizontal angle of only 100° of the driver's view.

A further advantage of this system would be a considerable improvement of visibility in fog. It would only be necessary to install filters in front of the camera lenses to improve response to the longer wavelengths of infrared.

IDEA NOT NEW

The idea of using closed-circuit television does not appear so far-fetched if one remembers that Cadillac has already used a similar approach (a few years ago) to provide a wide-angle view to the rear in one of their experimental cars.

To pick out coloured traffic signs one might consider the use of colour TV as already used for viewing surgical operations remotely, in medical universities. The present design includes a wide-angle periscope for observing coloured traffic signs as well as for emergency uses in case of failure of the TV system. This feature can be seen in the drawing, which also shows the arrangement of the driver's seat and the video display.

The TV system permits the placement of the driver as well as the passengers in contoured seats arranged opposite to the direction of travel, so that the driver's view is to the rear. Proper shaping of the contoured seats (usually referred to as "bucket seats") will assure that the first impact in case of accident (which is nearly always frontal) will push the passengers into the seats and provide proper bracing for the whole body, including the driver.

Front and rear seats are rigidly connected to each other and as a result of the impact they will move in unison toward the retarding mass of the padding, or braking material, designed to decelerate the body at a safe rate. The required constant deceleration can be accomplished by selecting braking material of the proper density, as stated above.

SPACE PROBLEM

Admittedly the inclusion of such a decelerating-mass cushion inside the vehicle will occupy some of the interior space. To minimise this disadvantage the same part of the interior can also store other safety items, such as padding panels which, upon impact, would automatically shoot in front of the windows and other potentially dangerous areas, such as any hard objects in the interior.

A complete covering of potential danger spots assures that later impacts during an accident, which are not always frontal ones, would also not be likely to injure passengers. With reference to the padding, one may think of the excellent protection given by crash helmets; they are so effective that many law-enforcing agencies suggest their use.

The rather radical solution discussed above should not be considered an impossibility at the present state of the art. It was presented with a view to pointing out possible future development of the automobile. It was, however, also discussed for the purpose of introducing compromise solutions for which technology has the means now and for which today's traffic is more than ready. (From "Radio-Electronics.")

Are your playing hours wearing out?

The smooth, perfectly rounded B.M.B. needle rides the record grooves evenly. When the needle no longer looks like this, the sound is not hi-fi.

The so-called "permanent" needles sold with modern record reproduction equipment will wear out, contrary to the usual belief. These needles actually have an effective playing life of approximately 40 playing hours . . . then the smooth radius starts to wear, the needle sinks lower in the record groove, the delicate sound track is chiselled away.

This worn needle rides lower in the groove than a good needle and planes off sound with every playing.

The B.M.B. range of sapphire styli includes over 30 different types—most available with diamond point, and interchangeable with other brands.

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SCIENTIFIC & INDUSTRIAL NEWS

NEW TRANSISTOR

TRANSISTORS made on a new principle can switch twice as fast as silicon transistors now available. The new production principle is called epitaxial. It depends on the vapour deposition of the semi-conducting material—atom by atom, so to speak. The collector is a low-resistivity material.

On this an extremely thin layer of semi-conductor is built as a single crystal. The "doping" is also done by vapour deposition. In this way an extremely high transistor can be made, and as the frequency at which a transistor is effective is limited by the time taken for electrons or "positive holes" to go across the middle layer of a transistor, the thinner the layer the higher the frequency it can be handled.

The two now available can switch in a few thousand-millionths of a second (24 nanoseconds), more than twice as fast as the best silicon transistors available commercially. The devices are likely to be used in electronic computers but they can also be used as general-purpose transistors when the signals being handled are small.

Texas Instruments, Central Research Building, 13500, North Central Expressway, Dallas, Texas, U.S.A.

HOVERCRAFT ON RAILS

APPLICATION of the hovercraft principle to rail communication is causing considerable interest in America. The use envisaged is a short goods train to be supported on a current of air and guided by a single rail.

The patented form consists of two big lorry bodies connected in tandem and powered by a motor cab at the front end. Fans built into the lorry bodies would raise them a few inches off the ground and a turbo-jet engine mounted on the roof of the motor cab would provide the forward movement. Horizontal wheels below the bodies press on the guide rail.

The patentee foresees speeds of 100 to 300 miles per hour for this air-supported train.

Col. Harry A. Toulmin, Jr., **Commonwealth Engineering Company of Ohio,** 71 Springfield Avenue, Dayton 3, Ohio, U.S.A.

MEASURING ELECTRICAL WAVEFORMS

THE differences in waveforms produced by electrical variations are an important factor in determining the behaviour of equipment. One problem has been that these variations are not those of a "pure sine curve." Because of this certain types of voltage or current readings as, for example, a conventional Route Mean Square one, can be misleading.

To overcome this difficulty, a factor known as the "form factor" has to be measured. Essentially this is the relationship between the conventional R.M.S. value and the mean waveform recorded.

A new form factor instrument with several different scales is now being made by the Sensitive Research Instrument Corporation. The instrument has several scales. These show the ratio of R.M.S. value to average, and the ratio of positive and negative peak values to R.M.S. value. It is claimed to be accurate over a range of frequencies from 25 to 500 cycles per second. The accuracy is 0.2 per cent for fairly small values of the ratios. At a frequency between 500 and 1,000 cycles per second the comparable accuracy is 0.3 per cent.

Ad Auriema Inc., 85 Broad Street, New York 4, U.S.A.

"THROAT" PHONE

A SPECIALISED telephone designed for use where outside noise tends to drown the speaker's voice, or where face masks—such as gas masks—make direct speech impossible, has been developed by a Tokyo company.

The battery-operated device uses the principle of the "throat microphone," which is placed against the speaker's throat. It picks up vibrations directly from the vocal cords and transforms them into electrical impulses.

Development of the telephone has been subsidised by the Ministry of International Trade and Industry.

Gelma Kogyo Company Ltd., 49 Kageoka-cho, Shibuya-ku, Tokyo, Japan.

FLAW DETECTOR

A NEW miniature flaw detector weighs only 28lb and uses ultrasonic techniques to measure the thickness or the existence of flaws of all types without the use of any ancillary equipment.

The equipment is provided with a five-inch fine definition high-brightness display, and can be used either for working with a single probe or working with two probes operating together. When it is used for routine inspection, an exceptionally clean trace can be obtained by using a special control which permits the echoes, which indicate the presence of small defects, to be compared with echoes produced from other factors of less or no importance, such as spurious grain boundary echoes. In order to prevent this facility from being misused, a warning light burns when this particular control is in operation.

A range of special probe manipulators can be used with the machine to enable the ultrasonic beam to be aimed in virtually any direction, allowing the accurate inspection of irregular shaped objects of different sizes to be carried out exceptionally easily and with very great accuracy.

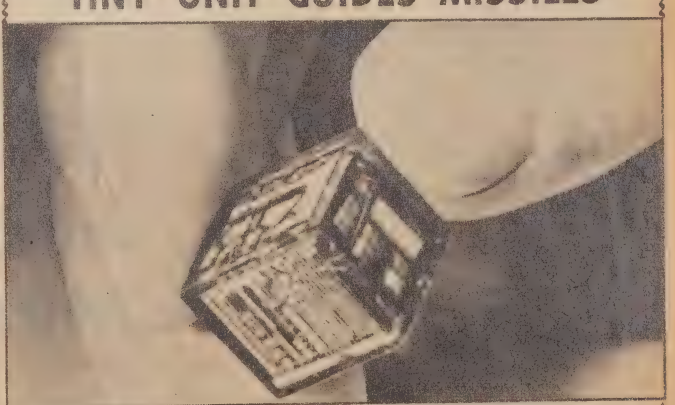
Ultrasonoscope Company (London), Sudbourne Road, Brixton Hill, London, S.W.2, England.

COPPER PLATING

A NEW process for copper plating is said to give far better results than any other copper plating method so far used.

It is said to yield exceptionally close-grained, smooth deposits which do not

TINY UNIT GUIDES MISSILES



A new technique for "shrinking" missile components—to reduce weight and size—is demonstrated by this thumbnail size package which contains a complete amplifier circuit. The amplifier, developed by the General Dynamics Corporation of America, is part of the infra-red guidance system of a missile. It is a solid block of plastic containing transistors, resistors, and capacitors. Although no dimensions or other details are given, some idea of the size can be obtained by comparison with the model's fingers. It is probably no larger than three eights of an inch cube.

POWERSTAT

variable transformers

Powerstat variable transformers, from the Superior Electric Co. of America, are auto-transformers of toroidal core design with moving brush taps which deliver any voltage from zero to above line voltage.

The wattage loss of Powerstats is extremely low when compared with rheostats and other resistive controls. Regulation is particularly good, with only a negligible variation in output current from no load to full load current.

Adjustment can be made to a fraction of a volt because the brush tap is always in contact with one or more turns of the winding.

All Powerstats are conservatively rated and the current rating gives the currents available over the entire voltage range.

Powerstats introduce no distortion and give an output waveform that is a faithful reproduction of the input. This lack of distortion results from advanced core and toroidal design and the use of the highest grade of silicon steel.

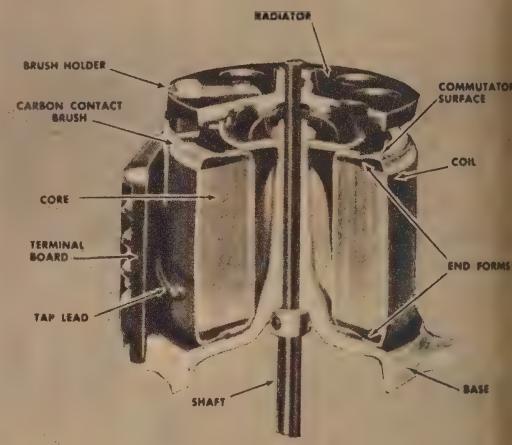
The full range of Powerstats covers single phase, three phase, three wire, two wire, line to line and open delta to 217 Kva, also motor driven, temperature modulating, portable, oil-cooled, explosion proof, line correctors, double winding and limited range types.

We have now imported limited stocks and our range of items held will probably be expanded from time to time.

The transformers imported are of enclosed construction for general utility mounting with open terminal strips. Input voltage is 240 volts 50-60 cycles while the output voltage is continuously variable from 0-280 volts.

Basic specifications and prices are:

Type No.	Amps.	Rating Max. VA	Duty Paid Price F.O.B. Sydney
S.14012 (216)	3	840	£17/13/6 ea.
226	6	1700	£29/2/6 ea.
236	9	2200	£41/10/ ea.
126-2 (ganged)	12.5	3500	£66/8/ ea.
1256 C	28	7800	£98 ea.



CUT-AWAY VIEW OF THE CONSTRUCTION OF A POWERSTAT VARIABLE TRANSFORMER

Jacoby, Mitchell & Co. Pty. Ltd.,

469-475 Kent Street,
SYDNEY. N.S.W MA8411.

Also at: MELBOURNE—113 Bridge Road, Richmond, Vic. JB5100
ADELAIDE—77 Wright Street, Adelaide, S.A. LA5117
NEWCASTLE—135 Beaumont Street, Hamilton, N.S.W.
MA4744

ger mark or "spot out." It is also
f to produce faster platings than pro-
ses using acid or cyanide solutions
ler normal operating conditions. This
ecause it enables higher current den-
es to be used. The process is also
l to have excellent throwing power.
At the same time, it eliminates the
d for fume extraction—since no cya-
e is used—and also problems asso-
ted with the disposal of effluents. It
olves the use of a solution, which is
y mildly alkaline and does not attack
t alloys to any marked extent. It
produces a deposit which is non-
ous and therefore is useful in nitrid-
, or barburizing process for steel.
The operation of the process depends
the use of a new electrolyte, based
a pyro-phosphate compound.

Albright and Wilson (Mfg.) Ltd., 1
ightsbridge Green, London, S.W.1,
gland.

HEATING TAPES

A NEW type of electrical heating tape
s (used in industry to compensate for
t losses in pipelines, to raise the
perature of fluids in pipelines or tanks
to protect steam and water pipes
inst frost) has elements made of thin
al foil instead of the more usual
nd wires. This type of flat element
tated to give improved heat flow as
ies very close to the object to be
ted and heat can flow from the whole
face of the element. Moreover, it is
med the element achieves the desired
lt at a much lower temperature than
omparable round wire element.
Six of the flat elements are laid side
side in a 1-inch wide tape and they
both individually and collectively in-
ated with a plastic material. In a
ch width of tape, it is stated, ¾ inch
eating surface.

M.E.I. Company, Wolverhampton,
gland.

ALL-GLASS "PAPER" INSULATOR

CARYING applications are being
found for an all-glass insulating
per" called Tissuglass, developed in
United States to solve unusual electri-
thermal and electronic problems.
upplied in sheet form and made from
emely small glass fibres on a speci-
adapted paper-making machine, the
terial, uniform in texture and electrical
stance, is claimed to have unusual
lating properties. Its melting tempera-
is above 1,200 degrees Fahrenheit
thickness ranges from .0006 to .012
n.
ne of the newest applications for
uglass is as a base for electrolumi-
ent lamps which are in the form of
ible panels as thin as 1-16 inch. It
lso being used as a component for
ted circuit materials in which it is
inated with very thin copper foil.
he material is produced in rolls up to
inches wide.

QUICKER COOLING

THE use of a liquid nitrogen spray is
expected to reduce the time refrig-
ed lorries have to stand idle while
temperature within them is reduced
iciently for frozen foods to be loaded.
eveloped in the United States, the
gen system not only pre-cools the
y of the lorry but also displaces any
warm air within it. The liquid nitrogen is sprayed into the body where it vaporises. Frozen foods can then be loaded at once without waiting for the vehicle's own refrigeration system to reduce the temperature.

U.S. Department of Agriculture, Washington 25, D.C., U.S.A.

APPLYING PLASTIC FOAM

NEW equipment has been developed for applying plastic thermal insulation material at high speed.

The material used for producing the insulation is polyurethane foam, which is applied in liquid form by a special spray gun.

As soon as the material strikes the object being treated it spreads over its surface in a thin film and then gradually turns into a bubbling and expanding mass of white plastic foam which quickly hardens into a 2-inch layer of rigid material.

Apart from applying the material to insulate the roofs of houses and the spaces between ceiling joists, the equipment is particularly suitable for spraying foam around tanks, pipes and hot-air ducts.

Aerograph - De - Vilbiss Company, Lower Sydenham, London, S.E.26, England.

NYLON BEARINGS

NYLON tubes in well over 100 sizes from which bearing and other components can be machined are now being manufactured.

It is claimed that lubricated nylon bearings will operate under similar load and speed conditions as orthodox phosphor bronze bearings and that they will often "out-perform" them.

Polypence, 68 Tewin Road, Welwyn Garden City, Herts, England.

RESISTING HEAT

A SHEET material which will give protection against great heat, up to 5,000 degrees Fahrenheit, is being marketed in the United States.

It is described as a glass cloth impregnated with silicone rubber and then faced with a coating of vapor-deposited aluminium.

The maker says the material will withstand ambient temperatures up to 500 degrees Fahrenheit and radiant heat up to 5,000 degrees Fahrenheit when this only strikes the aluminium face. It has been used experimentally in clothing for firemen and is now available commercially as either film or tape.

Irvington Division, **Minnesota Mining and Manufacturing Co.,** 900 Bush Avenue, St. Paul 6, Minnesota, U.S.A.

CAST TYRES

TYRES cast in synthetic rubber are being experimented with in America. They are tubeless and are made simply by pouring liquid synthetic rubber into a mould, which is then placed in a "curing" oven.

The tyres are translucent and can be made in a variety of colours. The company developing them says that tests have already been made at speeds up to 65 m.p.h. but adds that they are at least 10 years away from commercial production.

Goodyear Tyre and Rubber Co., 1144 East Market Street, Akron, Ohio, U.S.A.

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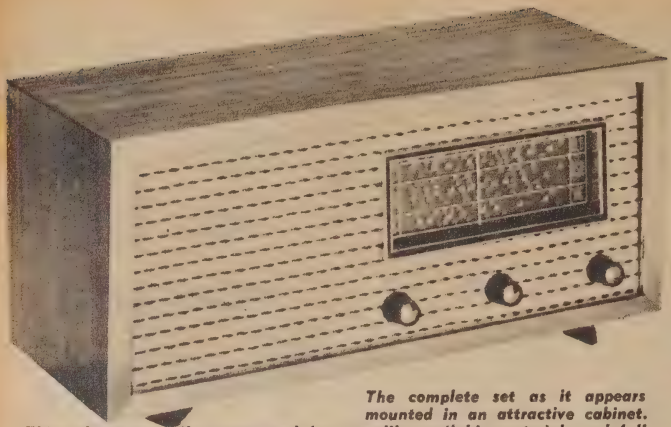


The complete set as it appears mounted in an attractive cabinet. This cabinet is easily constructed from readily available materials and full constructional details are being prepared.

Little General For 1961—Part Three

Here is the third and final article on the construction of our 1961 Little General chassis. Only a few extra components and a small amount of wiring are needed to bring it to the stage where stations can be received and final adjustments commenced. Details of these adjustments are given in some detail.

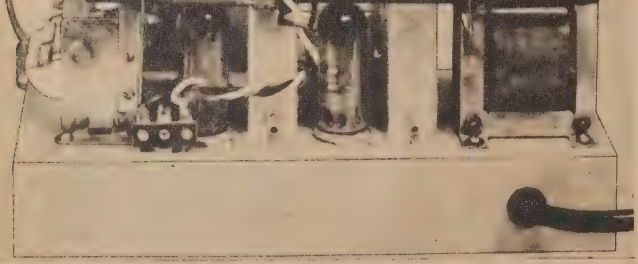
By Alan Nutt

LAST month we added the detector and IF amplifier stages to our receiver and discussed at some length the theory involved in a superheterodyne receiver.

We saw how the IF channel was used to provide constant selectivity across the entire band and how the local oscillator in the receiver heterodyned the incoming signal to the required intermediate frequency.

This month only a little theory is involved in the addition of the final components and we will deal in more detail with the alignment procedure which is necessary in order to obtain the very best performance from our completed set.

Considering the completed circuit



This rear view shows the general placement of the additional components; mainly the tuning capacitor, dial, and ferrite rod. Note the mounting brackets for the latter and the two trimmers on top of the gang.

which appears on the opposite page, will be seen that the 47K resistor, te porarily connected from the control g of the 6AN7 to the "F" terminal on first IF transformer has now been mo to its correct position as the oscilla grid resistor.

In addition, we have added the os lator grid capacitor. (47 pf), padder (4 pf) and one section of the ganged tun capacitor with parallel trimmer. T aerial section consists of the other s tion of the tuning gang — also w parallel trimmer — and the aerial mounted on the ferrite rod.

OSCILLATOR CIRCUIT

Before detailing the construct there are a few points that should mentioned, particularly in regard to oscillator.

Examing the circuit closely will sh that the 425 pf padder capacitor is fectively in series with the tun capacitance across the oscillator seco ary winding. Its effect is to reduce maximum capacity appearing across winding.

The reason for this will be obvi when we consider again the function the oscillator in the set.

Without going into detail, it may stated that the tuning range of a coil capacitor connected in parallel is eq to the square root of the change capacity. Assuming a minimum capa of, say 46 pF and a maximum capa of 415 pF, this represents a capacita change, of nine to one.

This means that the maximum tur range that can be covered using particular capacitor is three to one. actual frequencies covered will be termined by the inductance of the used with the capacitor. As an exam let us take the aerial coil which is signed to resonate at approximately Kc at maximum capacitance. This then set our upper frequency l around 1650 Kc, being a change of t to one.

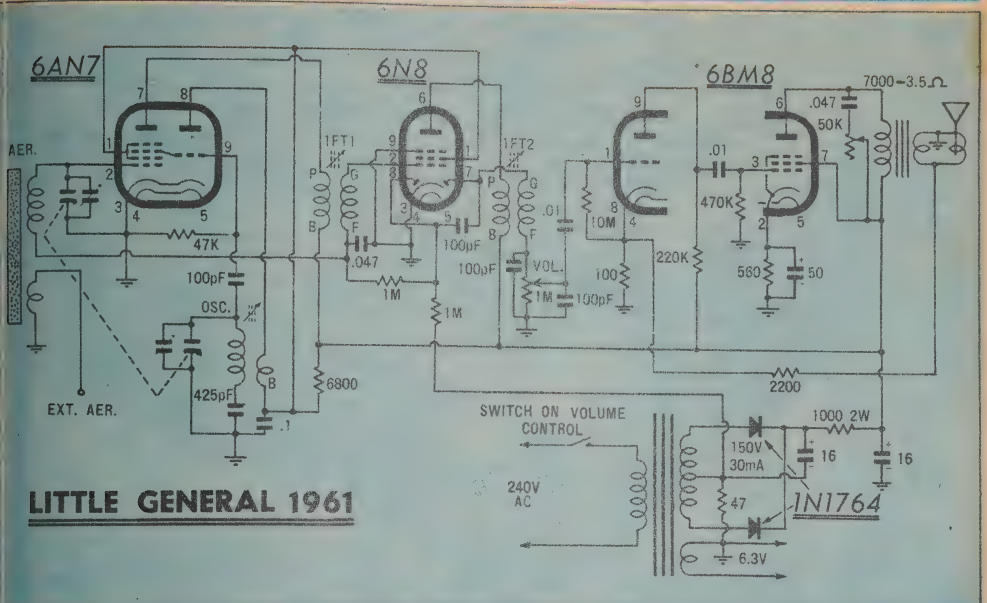
When we come to consider the o lator tuned circuit, however, we the proverbial "fly in the ointme

"TRACKING" PROBLEM

At a signal frequency of 550 Kc, oscillator frequency has to be 1005 in order to give a difference freque of 455 Kc. When the signal freque is 1650 Kc, the oscillator frequency then be 2105 Kc. It does not req much mental arthimetic to see that change in oscillator frequency is three to one as in the case of the si frequency tuned circuit but somethin lot less, approximately two to one to exact.

From this it can be seen that capacitance change in the oscillator cuit must be only four to one as aga nine to one in the aerial circuit. If s are not taken to provide this, the rece will not track properly across the tu range, the difference between oscill

ADDING TUNED CIRCUITS COMPLETES RECEIVER



The two tuned circuits to be added are the aerial and oscillator sections. Both use the two section tuning capacitor, plus the ferrite rod winding to complete the aerial circuit and the oscillator coil and padder for the oscillator. Trimmers are connected across each circuit to permit final adjustment.

d signal frequencies departing more d more from the required IF.

It is a relatively simple matter to ange the capacity ratio of one section the tuning gang. It is done in this se by placing the padder capacitance in ies with the gang, thereby effectively ducing its maximum capacitance. Of urse, the minimum capacitance is re- ced at the same time but only to a tall degree.

The trimmer capacitance across the ng is used to set the minimum capaci- nce to the required figure, thereby de- rmining the upper frequency limit. A cond trimmer is placed across the rial tuning capacitor in order that its inimum capacitance or upper frequency nit might correspond correctly with at of the oscillator.

OD TYPE AERIAL

The aerial coil itself is wound directly the ferrite rod, the function of which to concentrate the electromagnetic ies of force, radiated from the various ansmitters, into the immediate vicinity the coil. This tuned circuit will accept gnals in close proximity to the fre- ency to which it is tuned, maximum oltage being developed across the wind- g at exactly the resonant frequency. his voltage is then applied to the con- ol grid of the converter valve.

However, because the seleotivity is latively broad in this circuit, other sig- ls close to the tuned frequency will so cause voltages to be developed and ssed on to the converter. It is the func- on of the IF amplifier, with its much gher selectivity, to discriminate be-

PARTS LIST

1 Chassis 9½in x 4in x 1½in.
1 Power transformer, 150V a side at 30mA, 6.3V at 1.8A.
1 Speaker transformer, 7000 ohms to 3.5 ohms.
1 5in elliptical speaker (Rola type F or similar)
1 B/C oscillator coil (To suit 6AN7)
1 No. 1 IF transformer.
1 No. 2 IF transformer.
1 6BM8
1 6N8
1 6AN7
2 1N1764 Silicon diodes.

RESISTORS

(½W unless otherwise specified)
1 10 megohm.
2 1 megohm.
1 470K
1 220K
1 47K
1 6.8K 1W
1 2.2K
1 1K 2W (Or 2 2.2K 1W in par.)
1 560 ohm.
1 100 ohm.
1 47 ohm.
1 1 megohm potentiometer with SPST switch.
1 50K potentiometer.

CAPACITORS

1 50 mfd. 12V electrolytic.
2 16 mfd. 350V electrolytics.
1 .1 mfd. 200V paper.
2 .047 mfd. 200V paper.
2 .01 mfd. 200V paper.
3 100 pF ceramic.

SUNDRIES

3 9 pin noval valve socket.
1 8 lug tag strip.
2 3 lug tag strips.
18 ⅛" nuts and bolts, 3 ⅜" rubber grommets, 1 ¼" rubber grommet, power flex and plug, hookup wire, approx. 18" shielded wire or coax, solder lugs.

ADDITIONAL PARTS FOR STAGE THREE

1 Ferrite rod and aerial coil assembly.
1 Dial (USL/37 or similar) with ¼in to 3/8in bush.
1 6AN7.

RESISTORS

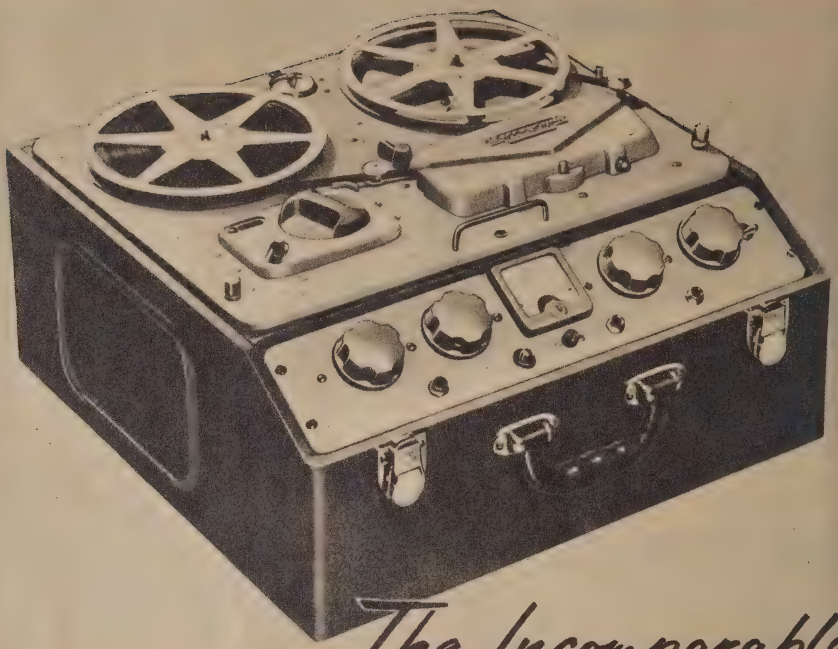
1 47K ½W.

CAPACITORS

1 2 gang tuning capacitor, approx. 415 pF per section.
1 425 pF 2% mica.
1 100 pF ceramic.
2 30 pF trimmers.

SUNDRIES

1 3 lug tag strip.
9-¼in nuts and bolts.
3 matching knobs.
Scrap aluminium for mounting ferrite rod.



The Incomparable
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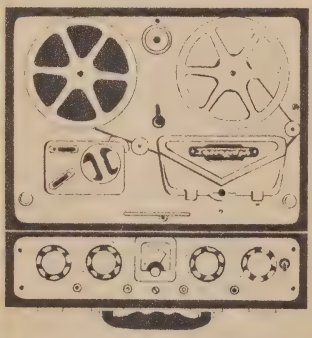

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These users have proven the reliability and qualities of the Ferrograph under circumstances far beyond your thoughts. But still one fact remains, the Ferrograph is truly INCOMPARABLE.

For illustrated literature, technical data and demonstrations, please contact

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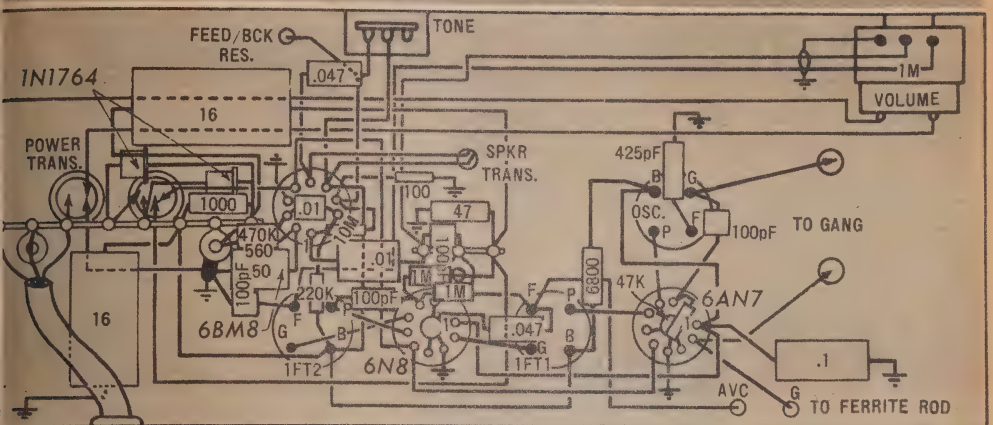
UNDERCHASSIS PHOTOGRAPH & WIRING DIAGRAM



This the wiring diagram for the complete receiver. Most of the additional wiring is associated with the two sections of the tuning capacitor, mounted at the right hand end of the chassis. Compare with the photograph below.

een the wanted and unwanted signals.

Coming to the constructional side, the ain assembly is the mounting of the ning capacitor, dial, and ferrite rod erial coil. This is fairly straightfor- ard, but a few points are worth noting.

The dial drum, normally screwed to e dial frame when purchased, should unscrewed and mounted on the tun- g gang shaft. A ¼in to 3/8th inch ush will be necessary to match the um to the gang shaft and it is wise check that this is included with the arts.

Holes will be required in the chassis order to pass the dial cord through the spindle. The dial cord itself will ve to be removed during the mount- g process and it may be a wise pre- ution to make a sketch of its layout fore removing it from the drum and dial. Otherwise a very frustrating time can be spent in figuring out just which way it should be put back.

From the photographs it should be clear how the ferrite rod assembly is mounted. Two small brackets are made from scrap aluminium and bent so as to mount on the tuning capacitor and the top of the power transformer. Two 3/8in grommets are slipped on to the rod, one at each end and these in turn are pushed into slots on the mounting brackets. The aerial coil must be left free to slide along the rod as part of the alignment procedure.

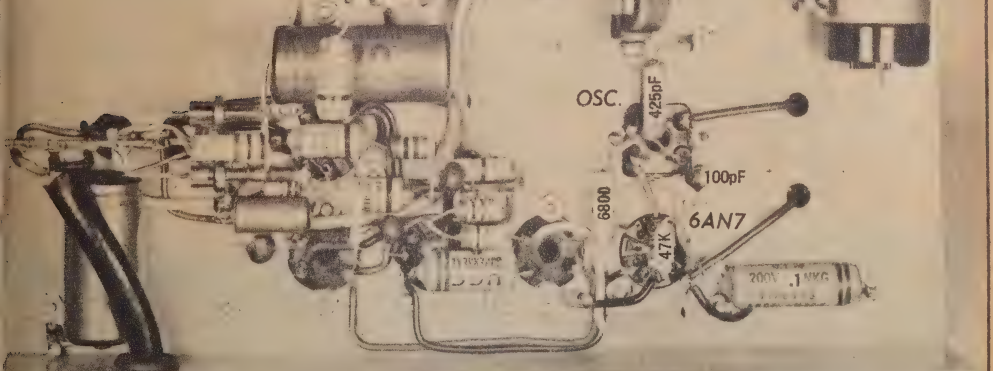
A three lug tag strip is mounted above the chassis just to the rear of the 6AN7 valve and from this tag the leads are run to the aerial coil on the ferrite rod.

One each of the two trimmers has to be connected in parallel with a section of the tuning capacitor. These are most conveniently mounted on top of each section, one lug connecting to the frame of the gang, and the other to the lug on the fixed plates. Note that the plate nearest the head of the adjusting screw should connect to the frame of the gang.

When soldering the trimmers to the frame it is a good idea to tin this first. This will permit easier fastening of the trimmers and also ensure that a good bond is achieved. A "dry" joint will make the tuning very erratic and some care should be exercised at this point.

Take careful note of the connections to the oscillator coil. These are normally marked on the base of the coil as indicated in the wiring diagram and must be strictly adhered to, otherwise the oscillator just won't oscillate!

The few remaining connections under



In this picture we have marked only those components and wiring to be added this month. It may help to compare it with last month's and also with the wiring diagram above. Note the two leads passing through the chassis to the tuning capacitor.

ANOTHER JR RELEASE

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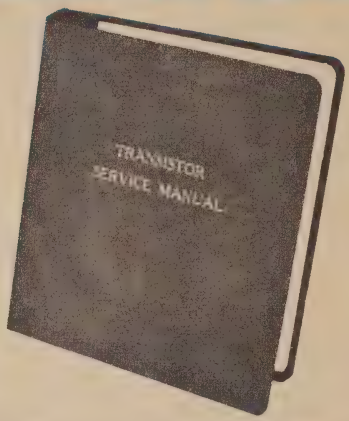
The only transistor repair manual to combine Australian and Japanese circuitry.



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1. Manual features circuit diagrams, layouts etc., for all Australian and Japanese Transistor Radios available and introduction to transistor servicing.
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QLD.: General Accessories Pty. Ltd., 50-54 Little Edward St., Brisbane.

S.A.: General Accessories Pty. Ltd., 55 Flinders St., Adelaide.

W.A.: W. Atkins (W.A. Limited) Mazda House, 894 Hay St., Perth.

chassis are relatively simple and are rly shown in the diagrams and un- hassis photograph. Note that the section of the tuning capacitor is l for the aerial circuit and the front ion for the oscillator.

When wiring is completed, check again any possible faults. Assuming every- g is in order, switch the set on and, r warm-up, tune across the band one end to the other. The chances that, even before alignment, stations be audible, although it is very un- y that they will correspond with the kings on the dial.

IGNMENT PROCEDURE

he alignment of the receiver is best ied out with the aid of a signal erator. However, we realise that y constructors will not have access uch an instrument and so we will uss the alignment procedure in the instance assuming no generator is lable.

he very first task is to set the dial ter so that its travel is logically re- d to the position of the tuning gang. sen the dial drum screws holding drum to the gang shaft and place the g plate fully in mesh. Set the ter to the end of the scale at the low uency end of the dial and retighten drum screws. Turn to the top end he dial and note if the pointer stops equal distance from the top of the e. If not, a slight re-adjustment may necessary.

ome dial scales have a small calibra- mark at the lower end of the dial which the pointer should be set with gang fully in mesh. This may or not be so, depending on the par- lar dial glass employed.

At this stage it may be assumed that IF transformers, as supplied by the nufacturer, will be fairly close to r correct settings and they should be tly left alone.

une the receiver to a station at the frequency end of the band (2FC for ance), and carefully adjust the SLUG he oscillator coil until the station ap- s at its correct calibration point on . This adjustment correctly sets the llator coil inductance to tune with maximum capacity of the gang to bottom of the band.

he aerial coil should now be moved g the ferrite rod until a point is d where the signal reaches maxi- n volume. This setting will be fairly cal.

TING TRIMMERS

une now to the high frequency end the band and select a moderately ng station around 1300 to 1400 Kc. r the setting of the oscillator trim- capacitor until this station also s up its correct position on the dial. low this with adjustment of the aerial mer for peak output of the same al.

check should now be made at the frequency end of the band to de- ine any change in setting of the llator coil slug, as the adjustment of oscillator trimmer may have some ct on the calibration at the low end he band.

he calibration of the stations across entire band should now be checked. t is found that the stations at the extremities are correct but that those in between are well removed from their correct positions, it is probable that the IF transformers are not set correctly on 455 Kc.

If this is the case, there is not very much that can be done until the IF channel can be aligned correctly on a generator. However, it should not prevent the set being used in the meantime.

This effect may also be due to an incorrect setting of the pointer in relation to the gang in the fully closed position and, where there is no set mark, it may be necessary to experiment a little to find the correct setting. However, this is best left until after the next step.

Taking the brighter approach and assuming that all stations "track" reasonably well, we can at least trim the IF transformers to bring them all to the same frequency, even if this is not exactly 455 Kc. Tune in a weak station anywhere on the dial and proceed to adjust the IF transformer slugs one at a time for maximum signal.

IF TRANSFORMERS

Commence with the top slug of the second IF, then the bottom slug, moving on to the first IF transformer and adjusting its slugs in the same order. Repeat the procedure a couple of times to make sure that all the settings are optimum.

Assuming a signal generator is available, the approach is somewhat different. For best results we also need an output meter, and this is available as part of most multimeters. It is connected between the output valve plate (6BM8 pin 6) and chassis, and provides an accurate indication of signal strength.

The first section to be adjusted is the IF Channel. Set the tuning capacitor fully open and connect the output leads across the aerial tuning capacitor (6AN7 pin 2 and chassis). Adjust the generator to 455 Kc and advance the attenuator control until a signal is heard in the loudspeakers. Keep the receiver gain as near maximum as possible and the output from the generator at a minimum. The slugs should be adjusted in the same order as previously stated.

OSCILLATOR COIL

Repeat the IF alignment and then transfer the generator lead to the Ext. Aer. terminal on the aerial coil. Set the generator to 600 Kc, the dial pointer also to this frequency, and adjust the oscillator coil slug for maximum output.

The aerial coil should be moved along the rod as mentioned before and peaked for maximum signal. When its position has been found accurately, it may be fastened in position with a strip of adhesive tape or two grommets pushed against either end.

Tune receiver and generator to 1400 Kc and use the oscillator trimmer to bring the signal to the correct point on the dial. Peak the aerial trimmer as before and alignment is completed.

Well, there it is. A set that we believe you can truly be proud of, particularly when fitted into its handsome cabinet, constructional details of which are in preparation. It will give you hours of listening enjoyment and will well repay the time and effort that has gone into its construction.

Strictly for

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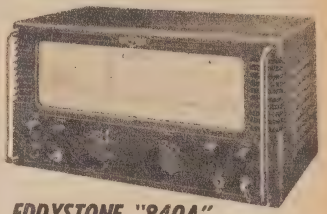

EDDYSTONE "840A"

Of sound design, and employing seven B8A valves in a straightforward superheterodyne circuit, the "840A" receiver fulfils the demand for a sensitive communication receiver at a moderate price. A speaker is fitted internally.

FREQUENCY RANGE

Band 1	30.6 Mc/s. to 10.5 Mc/s.
Band 2	10.6 Mc/s. to 3.7 Mc/s.
Band 3	3.8 Mc/s. to 1.4 Mc/s.
Band 4	205 metres to 620 metres.

ELECTRICAL PERFORMANCE: Sensitivity for 50 milliwatts, 15 db signal/noise ratio, better than 10 microvolts on all ranges.

SELECTIVITY: 30 db down 10 kc/s. off resonance. Image ratio: better than 15 db at 30 Mc/s. and greater at lower frequencies.

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PRICE: £101.1.2 plus Sales Tax (F.O.R.)

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Designed essentially for the amateur bands and giving full bandspread, this model is of the double superheterodyne type, possessing very high selectivity and excellent signal-to-noise characteristics. Special features are incorporated, e.g. crystal calibrator, audio filter, separate gain controls, and oscillator trimmer.

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ELECTRICAL PERFORMANCE: Better than 3 microvolts, 20 db S/N ratio, for 50 mw output, 30% modulation. Absolute sensitivity on CW better than 0.5 microvolts.

SELECTIVITY: Variable from 30 db to 60 db down, 5 kc/s. off resonance. Audio filter attenuates a signal 250 cycles off resonance by 30 db. Image ratio better than 35 db at 30 Mc/s.

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INSTROL PLAYMASTER No. 2

14 WATT STEREO AMPLIFIER

Specifications . . .

Performance figures and circuitry used as detailed in "R., TV & H." August, 1960. We supply best-quality components to "R., TV & H." specifications in all kits and completely built units.
POWER OUTPUT: A full seven watts per channel, rising to a maximum of eight watts per channel.
VALVES: Four—6BM8 in twin U.L output. One—12AU7 twin voltage amplifier.
RECTIFIERS: Two silicon diode 1N1763 rectifiers.
OUTPUT IMPEDANCE: 15 ohms. Others as required.
SWITCHING FACILITIES: (a) stereo: (b) stereo (reverse): (c) mono: (d) radio tuner; (e) spare.
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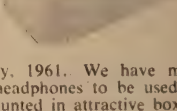
STEREO HEADPHONE ADAPTER

(R, TV & H Jan., 1961)



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FROM THE SERVICEMAN WHO TELL

This must be the "silly" season. After the story I told in the March issue I thought it unlikely that I would strike another "strange but true" for some time at least. Not a bit of it. Hardly was the March issue on the streets before I was listening to an even stranger tale from a col league. As I don't believe in being selfish, here it is for all to enjoy.

THE colleague who told me this story is a person of the utmost integrity. Even without the proof he was able to produce I would have no hesitation in accepting it. It simply emphasises that it takes all kinds to make a (serviceman's) world.

The story started out as a perfectly routine service call to a TV set. The owner had complained that the picture had vanished and been replaced by a thin bright line. These symptons my colleague immediately diagnosed as failure of the vertical oscillator circuit, probably due to a valve failure.

POPULAR SET

He was well acquainted with the particular brand of set, and knew that it used the popular 12BH7 twin triode arrangement, with one section as vertical oscillator and the other as output stage. So, making sure he had a spare 12BH7 in the kit, he set out to investigate.

A quick "switch-on" was all that was needed to confirm the symptoms, whereupon he unfastened the back of the cabinet and reached for the 12BH7. But, on withdrawing it, he was staggered to realise that it was the strangest 12BH7 he had ever seen.

It was the right size for a 12BH7, and the envelope was clearly marked "12BH7," but the "innards" were just about as far removed from a 12BH7 as they could be. (See photo.) In actual fact it appears to be the cathode assembly from a picture tube, together with a small ring at the top of the envelope, presumably acting as some form of anode.

It is no exaggeration to say that the sight of the thing positively rocked him. Not only was it a strange device by any standards, but it also posed the additional puzzle as to how it found its way into the set.

WHO DONE IT?

Tackling the second problem first, he immediately inquired of the owner as to who had been working on the set, only to be further confounded by the owner's emphatic denial that the set had been touched at all. He was quite adamant that the set had simply failed and he had called my colleague. As far as he was concerned the valve in question had been in the set since it was new.

As discreetly as possible my colleague pointed out that the valve in his hand was a "bodgie;" that the set could never have worked with it in place and that it could only have been fitted quite recently.

It was no use. That was the owner's story and he was sticking to it. And, since he was the customer, there was no point in trying to probe further, intriguing and all though the problem was. So he simply fitted a "fair dinkum" 12BH7, which restored the missing picture, checked the linearity, etc., and took his leave. (He was also careful to pocket the "bodgie" valve as proof of his experience.)

And that was more or less the story as he told it to me. There is very little I can add to it in the form of facts, though we did indulge in some quite interesting conjecture.

The prime questions, of course, are: how did this strange device come into being in the first place, and how did it find its way into the set? Almost equally intriguing was why the owner so vigorously denied that the set had been touched, when it quite obviously had.

In regard to the first question, there are several possibilities. According to another colleague, who spent his early years in a valve factory, ". . . some funny things go on in those places at

Ever seen a 12BH7 like this before? In spite of the marking, it appears to be a test set-up involving a picture tube heater cathode assembly.

times." From which I gather that valve factory employees are just as prone to practical jokes as most other factory workers; except that they have the means to express themselves in more subtle fashion than their mates in the biscuit factory across the way.

So the thing could have been a joke. However, I am inclined to doubt this. It was too carefully executed to be just a gag, and I am more inclined to the theory that someone had been making legitimate experiments with picture tube cathodes and had simply mounted them in the first envelopes that happened to be handy.

Which brings us to problem number two, how did it get into the set? We shall never know for sure, of course, but I suggest the following sequence of events as the most likely one:

First the vertical deflection system failed, producing the characteristic bright horizontal line. The owner, not wishing to incur the cost of a service call if he could avoid it, sought the verbal assistance of some obliging friend with a knowledge of TV. And, with such clear-cut symptoms, the friend would almost certainly pick the general nature of the trouble and even suggest the 12BH7 as the most likely culprit.

Thus the owner found himself looking for a 12BH7 and, I suspect, not wanting to pay much—or anything—for it if it could be wangled otherwise. haps he worked in a valve factory self (in a non-technical capacity, ously), or he knew someone who and promptly put the hard word them for a "spare" 12BH7 if should happen to be any lying arou

Exactly what happened next is more speculative than the sugges already made. All I can guess is someone began prowling around the tory looking—and probably asking- a 12BH7. But did they "find" it was it given to them? And, if the la was someone playing a practical j possibly with the intention of discou ing such "bites" in future?

LESSON LEARNED

As I said earlier, we shall prob never know. About all we can be tain of is that our friend the o will doubtless be rather more dis in future, should he have occasio replace any valves in his TV set.

Who knows, he might even decid buy one!

My next story is of interest m because it concerns a piece of equip not normally encountered by the ave serviceman, and because I think it trates the point that the majorit faults, even in unfamiliar gear, wil spond to a systematic approach. if you don't intend taking on any quite as strange as this, it may p comforting to know that it is w while "having a go" even if the does look a little strange.

The device in question was an tronic flash outfit belonging to a amateur photographer. It appeare be a home-made unit of some kind, the owner admitted that it was r old fashioned by modern stand While not knowing a great deal a such things, even I could see that it a good deal more bulky than the l models.

Nevertheless, he claimed it still a fine job, and since he used it r for "studio" work than as a port the extra bulk didn't worry him un But now it had packed up and he rather anxious to have it opera again in time to honour a photogra promise he had made to some fri or relatives.

USEFUL INFORMATION

Fortunately he had some idea on works of the thing himself, plu roughly sketched circuit apparently pared by the fellow who built it. hoped that this, plus my knowledge equipment, might be sufficient to en the trouble to be traced and repaire

I say fortunately because my knowledge of these things was limited. Apart from knowing how work in general terms and having the inside of some early comme models, similar to this one, I didn't

at deal to go on. The best I l hope for was that the fault idn't turn out to be anything too plicated.

ter studying the circuit for some and questioning the owner, I ged to build up some kind of a pic- It was a high-voltage type, work- t about 2500 volts, and the main itor was about 30 mfd. Power from a 6-volt dry battery, step- up via a vibrator and transformer. converted to DC by a pair of dry iers.

l this equipment was contained in main unit, the other section being gun which was mounted on the ra. It contained the triggering it used to provide the final pulse h fired the tube.

ERE TO START?

is much established I had to decide he best to start. Probable trouble appeared to be the vibrator car- ce, the transformer, the rectifier or main capacitor. If any of these d there would simply be no energy scharge through the tube. Alterna- y, if all these were intact, it could he trigger circuit which had failed, ning that there was nothing to fire ube.

decided to check the main supply if only because I felt a little more of myself in this section. Time gh to start pulling the gun to pieces the power supply had been proven

the other hand, even checking the r supply was not without its prob- n. Apart from the need to find some means of measuring 2,500 volts, I 't particularly happy about the idea aying with any voltage of this order , as in this case, it was derived from opping great capacitor of some 30 mfd.

ch a capacitor would have almost internal resistance and be quite cap- of delivering current at a rate of al hundred amps if the external it permitted. In other words, it ld like a "temporary" power line of ar voltage, and I had no wish to me the external circuit.

seemed to remember a story from past about someone who unthinking- orted one of these capacitors with rewdriver, after most of the energy been discharged through the flash). Even this small amount of resi- energy was enough to produce a t" that scared the daylight out of as well a biting a great chunk of the blade of the screwdriver.)

T PROBE

soon solved the problem of voltage surement. The high voltage probe nging to the VTVM and normally for TV EHT measurements is really 0 times multiplier, being most often in conjunction with the 300 volt te to read 30,000 volts. However, h used with the 30 volt range it s 3,000 volts; just a nice figure for job. What was more to the point, it a good deal safer with a probe his kind between myself and the e."

, with the works out of the case set up on the bench I traced out appropriate connection, prodded at it erly with the probe, and pressed the ging button on the gun. The vibra- buzzed and the pointer immediately commenced to move up the scale. Well, I thought, at least this much was working; the trouble must be in the triggering circuit.

But I had been too hasty. At around the 800 volt mark the needle commenced to waver and finally refused to rise any further, which was puzzling to say the least. I checked the battery while on load to make sure that it had no strange internal faults, which it didn't, then checked the high voltage side again. But no amount of charging would take the capacitor above the 800 volt mark.

Several possibilities occurred to me, mostly involving breakdown at the 800 volt mark, and the most likely seemed to be that of a failure in the capacitor itself. Not a very pleasant thought, since such components are expensive and could be hard to replace. Alternatively, it could be in the rectifier or the transformer.

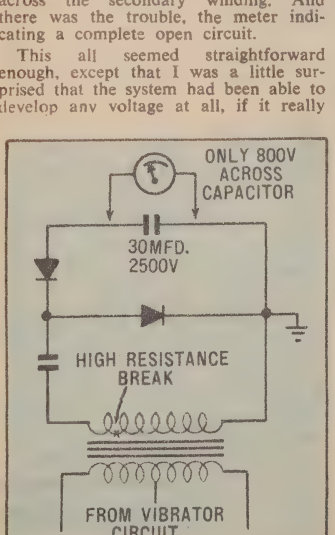
Mainly because it seemed to be the easiest, I decided to have a look at the transformer first. As far as I could make out from the circuit, the device employed some kind of voltage doubling system, so that the AC volts developed by the transformer were only around the 1200 mark.

Disconnecting the "hot" side of the transformer I endeavoured to check this value. It could be only approximate of course, due to the squarish wave form, but I hoped to get something near the nominal value. Instead, the meter behaved most erratically, reading only a few hundred volts and wavering badly. I decided it was time to check the transformer a little more closely.

NOT A BREAKDOWN

Although still thinking in terms of voltage breakdown to frame, I was puzzled by the fact that I had heard no sounds to support this idea. So, on an impulse, I clipped the ohmmeter leads across the secondary winding. And there was the trouble, the meter indicating a complete open circuit.

This all seemed straightforward enough, except that I was a little surprised that the system had been able to develop any voltage at all, if it really was open circuit. A more exact resistance measurement, using the higher ranges of the VTVM, showed the reason. There was some continuity in the winding, averaging around a megohm or so, but quite erratic in value and obviously due to some random leakage effect across the break.



The main fault in the electronic flash unit was an open circuit vibrator transformer secondary. However, leakage across the break allowed some charging action.

That much established, the next problem concerned a suitable replacement transformer. Fortunately, it was of local manufacture and it was a relatively easy matter to ring the firm and quote the type number. Our luck was in; although a discontinued type, they had a few on hand, and I arranged for one to be delivered as soon as possible.

When it arrived a couple of days later I was able to get right on with the job of fitting it; a somewhat tricky job in the confined space, but no worse than many "compact" devices of modern design. Then I set up the high-voltage probe again and pressed the charging button.

RESULTS AT LAST

There was no hesitation this time. The meter sailed merrily up to the 2,500-volt mark exactly as it was supposed to. And when I flicked the triggering lead against the chassis the lamp fired with a healthy "splat." I repeated the process several times, then dispatched a message to the owner advising him the job was complete.

When he came to collect the unit I took the precaution of checking it again in his presence, just to make sure that, being unfamiliar with it, I had not overlooked any vital point. However, all seemed well, and he was quite happy with the whole transaction.

Unfortunately, this state of affairs was short-lived. He was back early next morning complaining, almost apologetically, that there still seemed to be something wrong with it. More precisely, it appeared to have some kind of intermittent fault, since he claimed it would fire on some occasions and not on others.

I quickly set up the VTVM and probe again, hooked on to the appropriate terminal, and pressed the charging button. I was considerably relieved when the meter moved steadily up the scale again to the 2,500-volt mark. Well, at least my part was still working.

Then, almost before the charging cycle was complete, I closed the trigger circuit, whereupon the lamp fired with the now familiar "splat." I tried again, with the same result; then a third time and a fourth time, the lamp continuing to fire.

The owner, who had stayed to watch the test, pointed out that this behaviour was very similar to that which he had experienced. However, when he tried to take a picture the lamp refused to fire.

CAMERA CONTACTS

This immediately cast some doubt on the reliability of the camera contacts. Fortunately, he had the camera with him and I managed to improvise a fine probe which permitted the ohmmeter to be connected across the contact outlet. Then we fired the shutter several times, noting a positive kick on each occasion. So that seemed to be OK.

All of which seemed to throw suspicion on the trigger circuit, though, without at least some example of the trouble, there seemed to be little chance of my

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TYPE 28
Designed to give freedom of movement, this microphone is small and non-directional. Housed in a soft, moulded-rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.
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DESK TYPE
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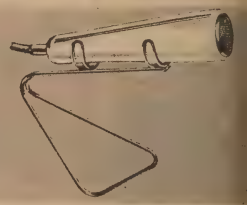
Pleasantly styled in two-tone colour to give a handsome, quality microphone of modest dimensions and unassuming price. Ideal for tape recorders with a minimum of stowage space available. £3/19/6.



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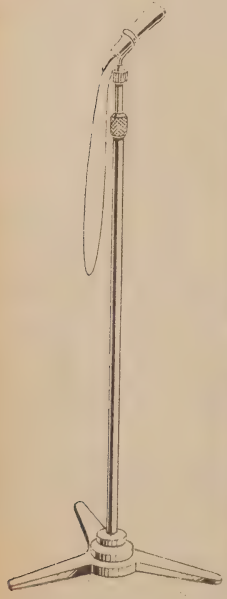

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TYPE MIC 38

Omni-directional frequency response	40-10,000 C.P.S
Sensitivity	—62 dB ref. 1 volt/dyne/cm (approx. 1mV)
Load resistance	5 megohm
Effective capacity	880 p
Maximum diameter	1.125
Minimum diameter	0.75

PRICE: £4/19/6

TYPE MIC 43

Output level	—50 dB ref. 1 volt/dyne/cm (approx. 3mV)
Capacity	800 pF approximately
Omni-directional frequency response substantially flat	40-6,000 c.p.s
Recommended load	Not less than 4.7 megohm
Maximum diameter	1.75
Minimum diameter	1.5

PRICE: £2/15/6.

FLOOR MICROPHONE STAND
(Shown fitted with MIC 39 and adaptors)
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ng it. An intermittent in a photo- unit might well prove worse than TV set, at least to one not ex- enced in this kind of thing.

opened up the gun and had a look e trigger portion. The trigger trans- er was plainly obvious and I took opportunity to check continuity of primary and secondary, both of h seemed normal as far as I could At least there was no suggestion n actual open circuit.

charged the main capacitor again had another try, and this time the failed to fire. On the advice of owner I let it rest for half a minute o, then charged it and gave it an- try, whereupon it fired. Follow- this, I tried it several more times, times successfully, sometimes not.

owever, out of the successes and ires a pattern was beginning to . It seemed that if I closed the er circuit immediately the capacitor fully charged it would fire, but, waited even a few seconds, it would rally fail. A few more tries, with difference deliberately exaggerated, I was convinced.

took another look at the pencilled it and concentrated on the trigger on. It was a fairly simple arrange- t, the trigger transformer primary g connected in series with a .47 mfd acitor, the whole combination being ss part of the bleed resistor bridging main capacitor. I gathered that a age of about 200 was used to charge capacitor.

o fire the tube, the section of the d resistor was simply shorted out necting the charged .47 directly ss the transformer primary. Induc- e and step-up ratio did the rest.

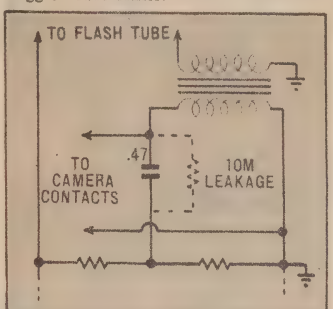
DIE OF THREE

n the face of it there wasn't much o wrong, apart from the transformer ready checked—the capacitor, and h resistor network supplying the cage. I had no way of knowing tly what this might be, but a check wed a little over 200 volts, and this ned reasonable.

his left the capacitor. It was a iple matter to lift it out, and I set up on the R/C bridge. First I ked the capacitance, which was well in normal tolerance. Then I checked h power factor. Here the unit seemed ginally less than perfect, there being nall but definite peak observable as h power factor control was moved htly away from zero.

hus encouraged, I connected the capacitor across the "megohms" range of the VTVM. And there was the story; around 10 megohms of leakage in a capacitor that should have been well up in the hundreds of megohms at least.

The whole picture was clear now. A capacitor with such a high order of leakage could not be expected to hold its full charge for any length of time, and was an obvious explanation why the unit would only fire immediately after being charged. After it had been left standing for a few seconds there just wasn't enough energy available to operate the trigger transformer.



The second fault was evident only in certain circumstances. It proved to be a leaky trigger capacitor in the gun.

Just to make sure, I picked a brand new .47 mfd out of stock (considerably smaller than the old one, incidently) and checked it on both the bridge and VTVM. Capacitance was normal and leakage so close to infinity on the scale as to make no difference. Then I tacked it into the trigger circuit and charged the unit up for another try.

There was no question about firing this time, even though I deliberately delayed closing the firing circuit for an appreciable time after the main capacitor was charged. After that I tried everything that the owner or I could think of to make it fail, but it proved to be completely reliable.

I fitted the new capacitor permanently into the gun, reassembled the latter, and passed it over to the customer. I gathered from his remarks that he was more than happy with the result. For myself, I felt that I had learned something about a previously unfamiliar piece of equipment; and that was something well worthwhile even in the job hadn't been particularly profitable.

NEW TIME-SAVING SCREWDRIVER

A NEW British screwdriver called the "Slotgrip," described by Michael Barratt in the B.B.C. General Overseas Service program "New Ideas," likely to save mechanics and handymen of all kinds a great deal of time nd exasperation in putting screws in awkward places or getting them out.

"This new tool," said Barratt, "which costs only a few shillings to pro- luce, contains down its spine a piece of metal which automatically twists ound when you press down its head. This torsion-bar action gives four oints of contact under tension, and the screw is locked on the end of the lade. Apart from being kinder on the nerves, the Slotgrip helps to reduce he time taken for servicing and assembly jobs—and time, of course, costs noney.

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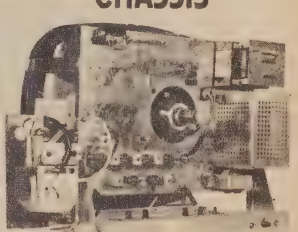

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Here's your answer, Tom!

This month, continuing our series on measuring instruments, we discuss audio oscillators. Basic operation of the two common types of Resistance-Capacitance oscillators is discussed, with a further brief section devoted to the Beat-Frequency type of Oscillator.

By JAMIESON ROWE

CIRCUITS designed to supply alternating signal voltages in the audio frequency range (that is, from say 20 cycles per second to about 20 Kilocycles per second) differ substantially from those intended for higher frequencies, such as discussed last month. This is not due to any fundamental difference in the type of oscillations required, but rather to the fact that tuned circuits, as such, tend to be impractical at low frequencies.

The lower the frequency involved, the greater are the values of capacitance and inductance required to produce resonance. Nor is it a direct relationship because, to halve the frequency of oscillation of a tuned circuit, the product of L and C must be increased by a factor of four. Thus values of inductance and capacitance required for low frequency tuned circuits become awkwardly large.

In addition, variation of L or C for tuning purposes becomes a problem when both are so large in value.

AUDIO OSCILLATORS

For these reasons, oscillators (and signal generators) for low frequencies have been developed in which resistance-capacitance frequency behaviour is used to promote oscillation, rather than inductance-capacitance tuned circuits.

The special advantage is that, in circuits utilising resistance-capacitance geometry, there is a direct relationship between frequency and the product of resistance and C. This means that, to halve frequency, the value of R times C has merely to be doubled, not quadrupled as before.

In addition, the provision of large values of resistance does not present great difficulties; nor does physical bulk become a problem, as with large values of inductance.

Audio frequency oscillators employing resistance-capacitance circuits rely upon the fact that an amplifier, using either thermionic valves or transistors, will oscillate if sufficient positive feedback is applied to it. In other words, if sufficient of the output of the amplifier is fed back to the input, with such a polarity that it tends to sustain the original input signal, the circuit becomes unstable.

Further, if the feedback circuit is arranged so that positive feedback occurs only at one specific frequency, then instability will cause the complete circuit to oscillate at that frequency.

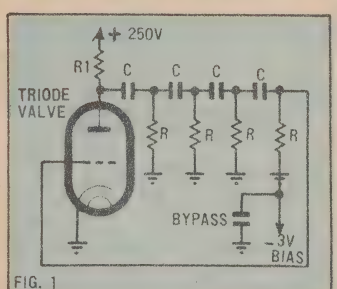

FIG. 1

Perhaps this will be easier to understand if we consider a practical circuit of this type. Figure 1 shows the circuit of a simple resistance-capacitance oscillator, commonly known as a "Phase-Shift Oscillator." As you can see, it involves a one-valve amplifier and a special resistance-capacitance feedback network between the plate and grid.

In an oscillator circuit employing only one stage, the feedback circuitry must not only feed back a portion of the output, but it must reverse its phase. This is because a normal valve amplifier, such as the one shown, itself reverses the phase of the signal applied at its grid.

REVERSES PHASE

When the grid becomes less negative during the positive half cycles of the signal, the valve draws more current, and the voltage drop across the plate load R1 increases. Thus the plate becomes more negative, and we say that the valve has reversed the phase of the signal. This is the same as saying that it has altered the phase by 180 degrees, as a full cycle is taken as 360 degrees.

So that the circuit may oscillate, the feedback must be arranged to be positive. This is performed by the four capacitors marked C in conjunction with the resistors marked R. These components form a network which has a phase shift of exactly 180 degrees at one particular frequency. This is the frequency at which oscillation occurs most readily.

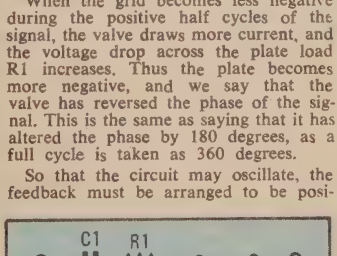

FIG. 2

For oscillation to take place, however, the valve must have an amplification which makes up for losses in the feedback network. Thus if the feedback network attenuates the signal from the plate by 30 times, the circuit will only oscillate if the valve amplifies a signal on its grid by at least 30 times. This is described technically by saying that the gain around the complete loop of the circuit equals or exceeds unity.

FOUR SECTIONS

The phase shifting feedback circuit shown consists of four identical series C-shunt R circuits cascaded. It is complicated by the fact that the final resistor is used as a grid resistor for the valve, and is taken to a bias supply instead of directly to earth. However, it is bypassed to earth at its lower end by a large capacitor, which ensures correct operation.

Another point of note is the impedance of the valve considered as a generator feeding the feedback network. This affects somewhat the phase shift of the first section of the network.

The circuit in figure 1 basically consists of an amplifier, which introduces 180 degrees phase shift, associated with a feedback network which supplies the other 180 degrees required for positive feedback. There is another type of R-C oscillator, however, which uses an amplifier having a phase shift of 360 degrees (which is the same as zero degrees for our purpose) in conjunction with a feedback network having zero phase shift.

The heart of this type of oscillator is the zero phase shift feedback network, shown in Figure 2.

A simple combination of two capacitors and two resistors, this network has a most interesting property. At one frequency, and at one only, it transfers the input signal to the output terminals with zero phase shift and an attenuation of 3. This frequency is found by the formula shown, for the simple case where C1 equals C2 and R1 equals R2.

The circuit for an oscillator using this network is shown in Figure 3 (a).

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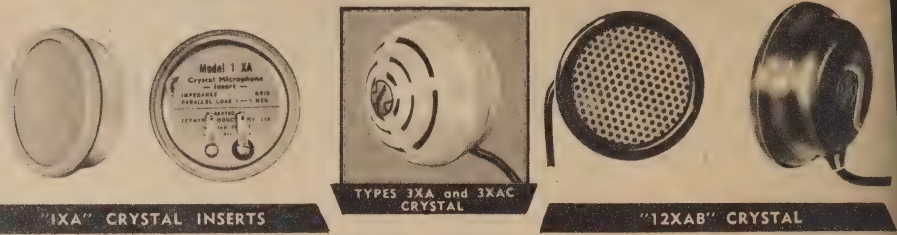

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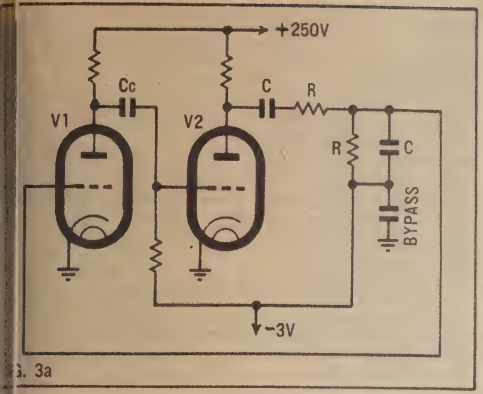


3a

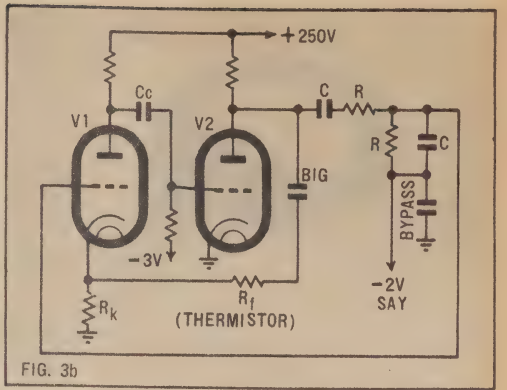


FIG. 3b

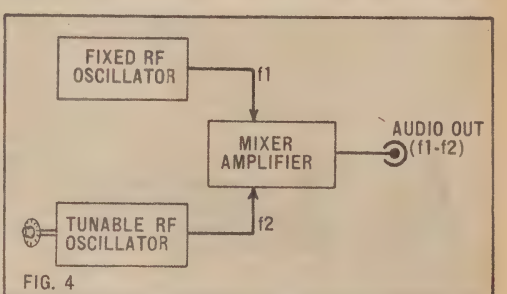


FIG. 4

e a two-valve amplifier circuit pro-
s a gain of more than 3 (to ensure
here again the loop gain is at
unity) with zero phase shift. The
phase shift network is used as the
back network, and the complete cir-
oscillates at the frequency passed
ero phase shift by the network.

aturally, the frequency of oscillation
be varied by varying either the
resistors in the network, or the
capacitors. A point to note is that
generator impedance of the second
e is effectively part of the resistance
he series part of the network, so
it must be kept low or allowed
in the circuit. (Note: By generator
edance is meant here the combina-
of the plate resistance of the valve,
the load resistor.)

EN BRIDGE

his circuit oscillates quite well, but
gain of the amplifier tends to vary
variations in supply voltages. In
tion, the waveform developed is
a pure sinusoidal wave, but is dis-
d due to saturation and cutoff
ts in the valves. To overcome these
ts, the modified circuit shown in
3 (b) was developed.

asically, this circuit is known as the
n Bridge, because the complete feed-
circuit may be drawn as a bridge.

esides the normal positive feedback
ork operating at the oscillation fre-
ncy, there is a negative feedback
it which is non-frequency sensitive.
tends to improve stability and to
ire a pure waveform. It purifies
veform because, while the positive
back sustains oscillation at the fun-
ental frequency, the negative feed-
attenuates severely all the har-
ics.

he negative feedback is performed
the two resistors Rf and Rk, with
rge value DC blocking capacitor
eries with Rf to prevent the plate
ge from the second valve plate
reaching the first valve cathode.

ote that direct feedback over two
es is positive if fed to the grid, but
tive if fed to the cathode, since a
tive voltage fed to the cathode has
same effect as a negative voltage
ied to the grid.)

o help maintain an even output level
the oscillator over a wide range
requencies, the feedback resistor Rf
ommonly made up in part or the
le of a thermistor, or negative tem-
ture coefficient resistor. This also increases the stability of the circuit against possible changes in component values with temperature.

The resistor Rk placed in the cathode circuit of the first valve has voltage drop due to the plate current of the valve, and thus provides a certain amount of so-called "cathode bias," equivalent to a negative bias voltage applied to the grid. To compensate for this, the circuit shown returns the grid resistor, which in this case forms part of the postive feedback network, to a source of (typically) —2 volts, instead of —3 as before.

Other circuits may allow the resistor Rk to develop all the bias for the valve.

In all the circuits we have been discussing, output may be taken from the circuit by coupling to one of the valve plates via a suitable capacitor. The signal may then be controlled in amplitude by a potentiometer, before being used for testing or other purposes.

The one remaining type of audio oscillator to be described is the Beat Frequency Oscillator (B.F.O.), which uses two tuned-circuit high-frequency oscillators to produce the audio output.

This type of "oscillator" relies on the fact that if two signals of different frequency pass through a non-linear device, they interact to produce (among other things) a signal having a frequency equal to the difference in the two original signals. This is commonly termed "beating" or "heterodyning," and is responsible for beat notes heard when radio signals are tuned on a freely oscillating regenerative receiver.

Using this phenomena, the BFO mixes two high frequency or RF signals in a non-linear valve crcuit to produce an audio beat note having a frequency equal to the difference in the two RF signals. One of the RF oscillators is fixed in frequency, on say 100 Kcs per second, and the other is tunable over a range say from 80 to 100 Kcs.

AUDIO REMAINS

The two signals are mixed, and the high frequency signals filtered out, leaving the desired audio beat frequency. Thus, when the tuned oscillator is on 80 Kcs, the output will be 100-80, or 20 Kcs. This is amplified and fed to the output terminals.

This type of audio generator thus produces low frequency oscillations in a manner which retains the ease of operation of tuned circuit oscillators, but without the disadvantages of circuits actually tuning to low frequencies. However, very careful design is necessary to minimise the production of harmonics along with the fundamental, and, in this respect, the B.F.O. is at a disadvantage, compared with the Wien Bridge type.

This completes the discussion of audio oscillators, Tom. Next month, we will look at audio distortion meters, wave analysers and power output meters, which are often used in conjunction with audio oscillators for audio testing.

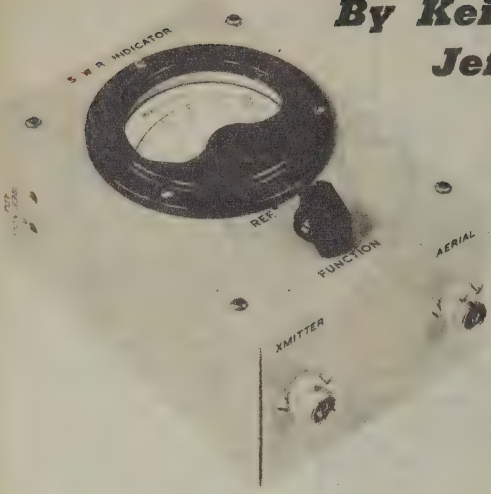
TV GOES LOCO!

Because of abnormal wear on sharp curves of the railway track between Umtali and Salisbury in Southern Rhodesia, engineers mounted a Marconi closed circuit television camera on a locomotive so that the action of the wheels could be observed while in motion.

Railway engineers mounted the camera on special brackets only a few inches from the wheels and track, and a monitor screen was installed in a private saloon. In this way it was possible to study the wheels actually in motion, and the camera was placed in a number of different positions so that all the wheels were viewed in turn.

A Standing Wave Indicator Unit

By Keith Jeffcoat



The photograph to the left is the unit complete in its case and shows the position of the two co-ax connectors and the forward/reflected switch, while that below shows the case removed and indicates the positioning of the various components including the sensitivity control which is not visible in the other photo.

Here is an extremely useful though simple standing-wave indicator designed for use with low impedance co-ax-fed antennas. The instrument has only to be placed between transmitter and feedline in order to obtain an indication of matching and may be left in circuit for continuous monitoring of transmitter and antenna performance, if so desired.

THE unit described has been in continuous service in our laboratory for some time and has proved its worth. Only a small handful of parts are required for construction, the most expensive item being a meter of reasonable sensitivity.

The more formal types of standing wave indicator usually consist of a length of co-ax, at least one half wavelength long on the lowest frequency in use, which has a number of taps along its length and into which a suitable RF voltmeter can be inserted.

This co-ax is coupled between the transmitter and the aerial and voltmeter readings taken at various points along its length. By comparing the minimum to maximum voltages so obtained, an indication of the SWR can be obtained.

This is all very well where an accurate SWR figure is required but it is scarcely necessary so far as the average amateur is concerned. All that is needed is an approximate indication of SWR so that comparisons can be made for example, before and after adjustments to a particular antenna.

It fact, the unit to be described can take most of the guesswork out of setting up a new antenna system.

Because, in one switch setting, its reading is proportional to aerial feed current, it will indicate quite clear whether changes in link configuration or coupler tuning are producing an increase or otherwise in the power fed to the antenna.

Again, because a flick of the switch indicates the standing wave condition the need for—or effect of—simultaneous adjustments at the aerial can be observed.

Correlating the two will produce optimum power transfer for a particular set of conditions and minimum standing wave ratio, which is a highly desirable state of affairs, to say the least.

From this basic condition, one can go on to observe the effect of different orders of L/C ratio in the final tank, different orders of applied voltage and loaded current and the corresponding of the plate current dip with maximum aerial current indication.

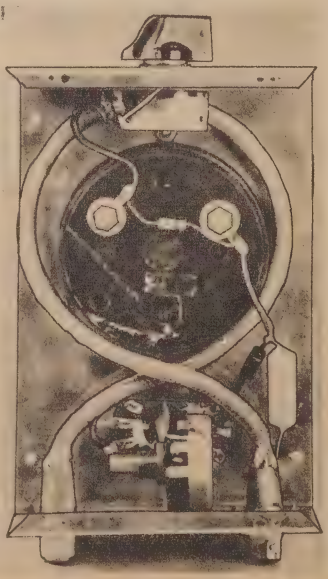
CO-AX PICKUP

None of these are simple functions of course, being influenced by other ratings and requirements, but observations involving them can be enlightening and can be interpreted with a view to obtaining the best end results.

Unlike its big brother, the commercial SWR indicator, our unit has only a short length of co-ax (15in) over which to make its measurement. Because this length is only a small fraction of a wavelength on even the highest frequency which we would expect to use, some form of measurement other than the point by point method mentioned earlier must be used.

It has been found that a good indication of SWR can be obtained by comparing the forward, or transmitted to antenna current, with the reverse or reflected current.

A simple way to measure the two currents, without running into constructional difficulties, is to insert a length of fine enamelled copper wire between the outer shielded braid and the inner insulated conductor of a piece of co-ax forming part of the transmitter-to-aerial feedline.



By terminating one end of the inserted wire lead with a non-inductive resistance equivalent to its own characteristic impedance and connecting the other end to a suitable RF voltage indicator, we are able to read the current flow in one direction. Reversing the end connections to the wire gives us the current in the other direction.

Briefly, the explanation for this rather surprising facility lies in the fact that the pickup wire inserted in the coax cable is exposed to both the capacitive and the inductive field within the cable.

The voltage induced on the wire by the capacitive field is not affected by the direction in which the signal is travelling. However, the voltage produced by the inductive field is governed by the direction of current flow.

It follows that the two voltages will add to produce a resultant of quite different amplitude, depending on whether the current is flowing in one direction or the other.

The principle can be utilised to p

a straightforward direction-of-flow tor or extended to indicate ac- ly both the forward and the re- current in a feedline—from the behaviour of the line and an- can be deduced.

actual fact, the facility is being as a matter of course into high- ed commercial transmitters. In cases, the sensing circuit is inter- l automatically with the power , so that the latter is interrupted / circumstance causes undue de- tion of the standing wave ratio.

IBRATION

instrument pictured at the head e article applies the idea in just its simplest form. It is intended e a purely comparative reading of rd and reflected current, without arily allowing for calibration in of the actual standing wave ratio. erring now to the circuit, the r R1 is a 200 ohm carbon non- ive potentiometer and is used as rminating resistor for one end of ine. The circuit comprising D1, 1 and R2 is the RF rectifying and ting device which connects to the end of the line.

switch S1A and S1B changes the and indicator from one end of the o the other.

ly the sensitivity control R2 and Forward/Reflected" switch S1 are ht out to the front panel. The nating resistor R1 is a preset l which has only to be adjusted during initial setting up. Once as been set, its value may be read an accurate ohmmeter and a fixed n resistor substituted, if desired.

ry little is involved in the actual ruction of the unit, the most us part being the insertion of the r wire inside the co-ax cable. This be simplified if the following ique is adopted:—

ke a 15-inch length of 50 or 70 co-ax and strip the outer plastic ing from it. The choice of either r 70 ohm will depend on the dance of the feedline in use. Bunch e outer braid as much as possible extract the inner conductor.

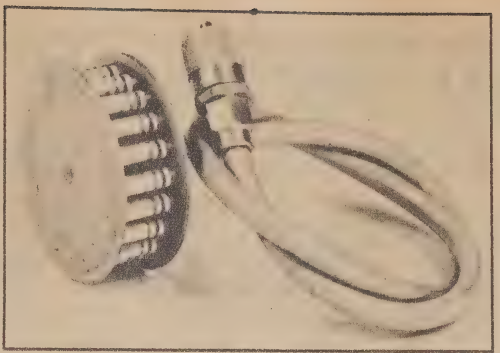
EMINATION

th a fine spike make a small hole -quarters of an inch from each end. a 20-inch length of 30 B&S elled copper wire through the e of the bunched braid and place nch length of spaghetti over each of the wire. Feed the centre con- r back through the braid and pull braid back to its original length. the spaghetti insulated ends of the wire through the two holes previ- made for it.

e spaghetti will prevent the braid scratching the insulation from the and so causing a short. Needless y, the enamel coating must itself be e suspicion.

rminate the ends of the co-ax into input and output sockets. Belling sockets with a shim brass shield red around them were used in our type, but any similar unit will do, nding on the type of connectors you ur.

e case is constructed in two parts, ront in which the meter is mounted constructed from 24-gauge brass , while the back is made from 18- e aluminium. The use of brass for front portion enables us to solder



The non-inductive load illustrated above is quite simple to construct and has the advantage of keeping the resistor lead lengths short.

our earths directly to the case, including the earth shields of the co-ax connectors.

The layout of the unit can be seen from the photograph. The sensitivity control is mounted at the top above the meter, while the preset terminating resistor R1 is mounted on a bracket beneath the meter. This bracket is soldered directly to the brass front panel immediately above the Forward/Reflected switch.

DUMMY LOAD

Before placing the unit in service it will be necessary also to construct a non-inductive load resistor of sufficient size to handle the full power output ot the transmitter. The choice of 50 or 70 ohms resistance will once again depend on the impedance of your feedline. This resistor is the "standard" against which your aerial system will be compared and it is no less important to the end result than the SWR indicator itself.

For best results, it is therefore vital that this resistor should be really non-inductive, and in order to achieve this it will be necessary to keep the resistor lead lengths as short as possible. The photograph of one load resistor which we have used shows a method of doing this.

Two copper discs 3 inches in diameter are used, with holes drilled in each to accommodate the resistors. This form of construction keeps the lead length down to one-eighth inch and leaves room, by increasing the size of the discs, for a heavy wattage load to be made.

DO NOT attempt to calibrate the SWR indicator by using a light bulb as dummy load. Light bulbs have a 10-to-one or higher ratio of resistance hot-to-cold, as well as having considerable inductance.

To calibrate the SWR indicator, leave the cover off the instrument, attach the dummy load to the antenna connector and the transmitter output to the transmitter connector. Set the selector switch to the "forward" position, energise the transmitter on the highest band used and load the transmitter into the dummy.

If the meter goes off scale, reduce the reading by means of the sensitivity control R2. With high power it may be necessary to further reduce sensitivity by means of the resistor RX.

The main purpose of this initial check is to establish that the meter can be controlled satisfactorily to full-scale deflection with the switch in the "forward" position.

Now switch to the "reflected" position and adjust the sensitivity control again until the meter reads full scale or as near to it as possible. Adjust the terminating potentiometer R1 for a null in the meter reading. If the dummy load is reasonably good, the null will be extremely deep, the meter dropping almost to zero.

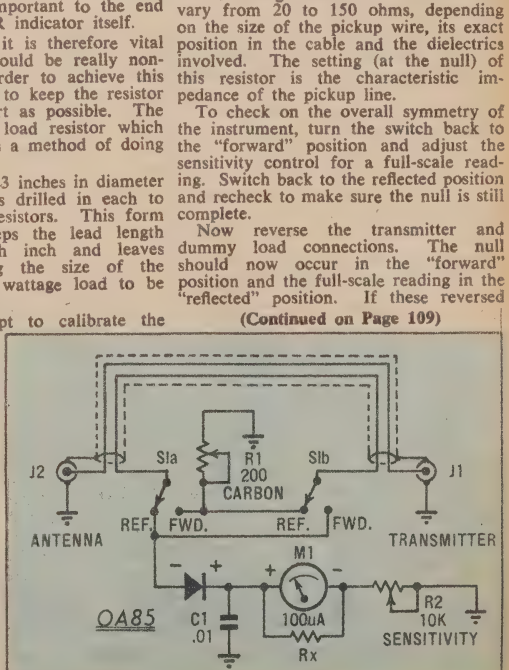
CHECKING SYMMETRY

The setting where the null occurs will vary from 20 to 150 ohms, depending on the size of the pickup wire, its exact position in the cable and the dielectrics involved. The setting (at the null) of this resistor is the characteristic impedance of the pickup line.

To check on the overall symmetry of the instrument, turn the switch back to the "forward" position and adjust the sensitivity control for a full-scale reading. Switch back to the reflected position and recheck to make sure the null is still complete.

Now reverse the transmitter and dummy load connections. The null should now occur in the "forward" position and the full-scale reading in the "reflected" position. If these reversed

(Continued on Page 109)



The circuit diagram shows the method of switching the pickup wire for forward or reflected reading. The resistor RX will only be needed where high power is used.

SPECIAL PURCHASES!

New 5 Valve Dual - Wave Radiogram Chassis

THESE NEW DUAL WAVE RADIOGRAM CHASSIS MADE BY LEADING MANUFACTURER ARE EQUIPPED WITH LATEST MINIATURE VALVES AND SUPPLIED WITH 12in ROLA SPEAKER. PACKING 10/- EXTRA **£16/15/-** F.O.R.

NEW 4 SPEED RECORD CHANGERS

THESE NEW 4 SPEED RECORD CHANGERS ARE EQUIPPED WITH HIGH FIDELITY CRYSTAL PICK-UP AND SAPPHIRE NEEDLES. CAN ALSO BE USED AS A MANUAL PLAYER.
SUITABLE FOR USE WITH ABOVE RADIOGRAM CHASSIS. F.O.R. **£10/15/-**

NATIONAL RADIO SUPPLIES

Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The "PILLOFONE" IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾ in. deep. POST FREE.

22/6

GARRARD RECORD CHANGERS 3-SPEED 32 V.D.C.

New English Garrard Record Changers fitted with high fidelity turn-over Crystal Pick-up, Sapphire Needles. For 32-volt D.C. operation. Can be used on any D.C. voltage exceeding 32V with External Resistance.

£9/15/- F.O.R.

NEW 4-SPEED PLAYERS

With turnover Crystal Pick-up

£8/10/- POST N.S.W., 7/6. INTERSTATE, 12/.

NEW STEREO CHANGER, 4-SPEED. F.O.R. £12/15/

NEW 4-SPEED STEREO PLAYER F.O.R. .. £10/10/

SLIDER-SWITCHES

10 pole 2-way silver plated contacts. 3/9

BURGESS MICRO-SWITCHES

Can be wired to switch circuit on or off. 3/9

SCOOP PURCHASE OF RESISTORS AND CONDENSERS

We have purchased the resistor and condenser stock held by Bush-Simpson who have ceased the manufacture of TV and radio equipment.

The resistors are mainly I.R.C. and include most standard values from 200 ohms to 5 meg. in ½, 1, and 2 watt. Also some wire wound. **List price 4/10/ per 100.**

The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in most popular values.

List price **£5/10/- per 100.**

SPECIAL PRICE

Resistors or condensers in boxes of 100 mixed values 20/. Post and packing 2/9.

NEW–10 WATT AMPLIFIERS

These 10w. P.A. Amplifiers using 6 valves, including EF86 Microphone Pre-amplifier and 6BQ5 valves in push-pull, with Ferguson Output Transformer with voice coil tappings of 2 to 15 ohms.

Inputs for Microphone, Radio and Pick-up with mixing facilities and tone control.

Unit supplied in Hammertone-finished metal case.

£18/17/6 Post: N.S.W. 10/, Interstate 15/.

12in Rola Speaker for above (10 watt), 57/6.
Crystal Microphone for Amp., 47/6.

NEW 25 WATT AMPLIFIER

As above but using 2-EL34 valves in push-pull output.

£26/17/6

Post N.S.W. 15/, INTERSTATE 20/.

NEW VALVES AT BARGAIN PRICES

6J6	12/	EK32	6/9	1K5G	2/6	6H6GT	2/6	6B6G VR55	5/
1C4	7/6	6SA7GT	9/6	1M5G	3/	6K7GT	7/9	VR65A	2/6
1T4	4/6	6SH7	5/6	1K7G	3/	6U7G	5/	7193	2/
3S4	10/	1L5	9/6	6J7G	5/	12A6	5/		
1R5	10/6	1O5G	2/6	6C8G	5/	7C7	3/6	EF50	2/6
1A7GT	9/6	1P5G	2/6	6SS7	8/6	78	7/6	12SH7	5/
1D8GT	9/6	1C7G	3/	6H6	2/6			6K7G	4/6
6K8G	6/9							1C6	7/6
6SJ7GT	9/6							955	2/6
12K8	10/							954	2/6

SPECIAL PRICES FOR QUANTITIES.
Please add postage on all valves.

NEW VALVE SOCKETS: Ceramic EF50 sockets, 2/6 ea. American moulded Loctal, 1/ ea. Octal 8-pin wafer, 6/6 doz. 5BP1 socket Ceramic, 7/6. Amphenol 5-pin ceramic, 2/6 ea. All post extra.

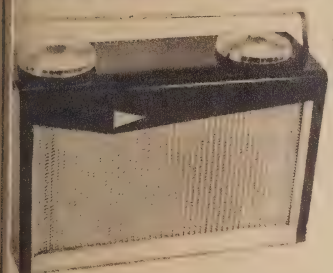
NEW MINIATURE COILS and I.F. TRANSFORMERS: Aerial, R.F. or Oscillator Coils, 7/6 ea. Post 1/-. I.F. Transformers, 9/6. Post 1/-. Short Wave Coils, 16 to 49 metres, 5/6 ea.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. Phone LM7398

MAKING A TRANSISTOR PORTABLE?

COMPLETE KIT OF PARTS for the TRANSISTOR SEVEN



with NEW R.F. STAGE

PRINTED CIRCUIT REDUCES HISS, INCREASES SIGNAL.

Avoid neutralising and critical layout.

£25/17/6 SET WIRED AND TESTED £2/10/- EXTRA

Complete kit of parts for the Transistor 7, including 7 Transistors, Printed Circuit Boards, Coil Kit, Rola 5F Speaker and Transformers and all necessary parts to complete this set including attractive and durable two-tone cabinet with gold trim. Fitted with special aerial coil and plug to connect to your car aerial or external aerial making it an ideal car set or for use in the country.

POSTING AND PACKING EXTRA on transistors 4 or 7 sets. } N.S.W., 15/-. INTERSTATE, 22/-.

NEW 9v RECORD PLAYER

£8/15/0

These new 4-speed Record Players are supplied with turnover crystal pick-up and sapphire needles, and are suitable for use with the above or any transistor radio.

Postage and packing extra. N.S.W. 10/; Interstate 15/.

NEW TAPE DECKS

ENGLISH TAPE DECKS, SHOP SOILED.

£18/10/-. Postage extra.

NEW 12in PER MAG SPEAKERS

These Standard Speakers by leading manufacturer (we cannot advertise the make) are supplied less transformer.

47/6 Packing extra. Post, N.S.W. 10/-; Interstate 12/6.

9in x 6in OVAL SPEAKERS

35/- Post, N.S.W. 7/6; Interstate 11/6. Plus packing.

Transformers for above speakers 5,000 or 7,000 ohms, 10/-.

BATTERY CHARGER RECTIFIERS

New Selenium Rectifiers, 6 or 12 volt, at 4 amp., 37/6. Post, N.S.W., 7/6; Interstate, 10/-.

Transformer for above rectifier tapped for 6 or 12 volt, with circuit for charger, 47/6. Post, N.S.W., 7/6; Interstate, 10/-.

As above, 6 or 12 v. at 2 amp., 27/6. Post: N.S.W. 3/6, Interstate 4/6.

Transformer for above, 37/6. Post: N.S.W. 3/6, Interstate 4/6.

NEW. RECORDING TAPE.

Well known make Hi-Fi Recording Tape, P.V.C. base. 5in spools. 600ft. 20/. Post 1/6.

SARLON HI-FI GRILLE FABRIC AT HALF PRICE

Popular colours, 54in wide, 25/ per yard. Post extra.

DUAL CONCENTRIC POTENTIOMETERS

meg + 200K + switch.
meg + 50K + switch.
meg + 5K.
meg + 10K.
meg + 20K.

6/6 ea

NEW 5in PER-MAG SPEAKERS

5T or 7T Trans.

30/-

Post and Packing, 3/6.

SINGLE CRYSTAL EAR PHONE 7/6

STANDARD INTERMEDIATE FREQUENCY TRANSFORMERS

455Kc, 1¼in square cans. Slug tune. 4/9 post extra.

EXTENSION SPEAKERS

New Rola 9 x 6 speakers in case with volume control. 75/. Post Interstate 5/6. N.S.W., 4/.

ELECTROLYTIC CONDENSERS

New condensers.

mfd 525v 2/9
5mfd 600V 5/9

Post Extra

TV OR AMPLIFIER POWER TRANSFORMER

240V Pri. Sec. 260 x 260V at 300 MA. Two 6.3V windings at 4.5A and 5V at 6A. 55/.

Post N.S.W. 10/. Interstate 16/.

80mA TRANSFORMER

240v pri., sec. 285 x 285, two 6.3v fil. windings and 5v. fil. windings.

32/6

Post: N.S.W., 5/; Int., 8/6.

NEW POWER TRANSFORMERS

60mA prim.: 240v with 230v tapping. Sec. 285 x 285 with 6.3v filament winding 60mA.

25/- Plus postage, N.S.W. 3/6, Int., 5/3.

NEW MIDGET POWER TRANS.

40mA prim., 250v. Sec. 225 x 225 with 6.3v Fil. Winding.

27/6 Postage: N.S.W., 2/6; Interstate, 4/6.

30mA 240v Prim. 150 x. 150v. Sec. with 6.3 v Fil. Winding.

25/- Postage: N.S.W., 2/6 Interstate, 3/6.

MICA CONDENSERS

Standard Mica Condensers, small current types .00003 and .005, including most wanted values.

10/- per 100. Postage 1/6.

NEW CRYSTAL MICROPHONES 50/-

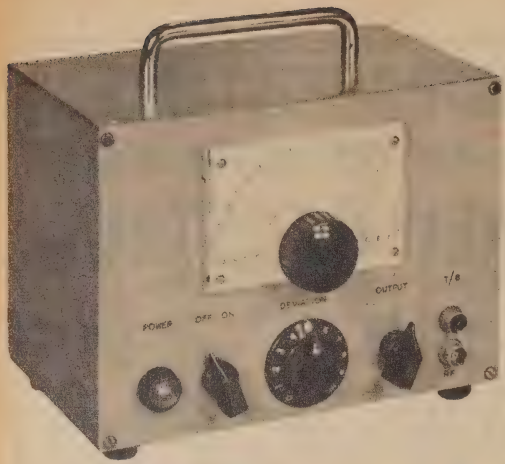
NEW POTENTIOMETERS

with SWITCH STANDARD SPINDLE	WITH SWITCH SHORT SPINDLE	LESS SWITCH STANDARD SPINDLE	LESS SWITCH SHORT SPINDLE	TAB. POTS.
25,000 ohms 100,000 ohms 5/6 ea. 50/ doz.	100,000 ohms. 500,000 ohms. 2/6 ea. 24/ doz.	100,000 ohms. 500,000 ohms. 500 ohms. 5,000 ohms. 3/6 ea. 33/- doz.	50,000 ohms. 100,000 ohms. 500,000 ohms. 2 meg. 1/9 ea. 16/ doz.	25 k. 250 k. 1 meg. 2 meg. 2/- each.

25,000 ohm screwdriver adjustment, 1/9.

NATIONAL RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W. Phone LM7398



Here is the unit complete in its case. The use of an instrument type dial leaves provision for calibration to suit any of a number of different coils which may be used in the unit, to cover different frequency bands.

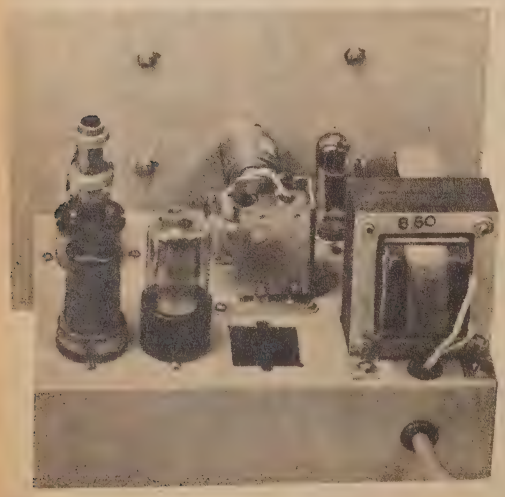
A Narrow-Band Sweep Generator

Last month we described the construction of a practical 450Kc filter for inclusion in your present amateur-band receiver. The successful performance of that unit depended on its being correctly aligned, so this month we describe the construction of a simple sweep generator which we have found to be completely adequate for the job.

By KEITH JEFFCOAT

AS mentioned last month, it is actually possible to align the filter by the point-by-point method, using only an accurately calibrated signal generator and a VTVM. It is, however, a time consuming and boring task, which is likely to bring about a violent explosion of temper long before the filter assumes anywhere near the correct waveform.

It is in the performance of this task that the sweep frequency oscillator or "wobbulator," as it is often called, comes into its own. Its use normally saves a lot of time while, in most cases, the skill required is less than that involved using other instruments or techniques.



This rear view of the instrument shows the placement of the major components. The two valves at the left of the chassis are the 6AC7 reactance valve and the 6SN7 oscillator. The 6X4 rectifier is at the rear of the transformer.

Before going into the construction details of our unit, it may be worthwhile to discuss some of the fundamentals of wobbulators.

Basically the wobbulator is an R signal generator whose output remains constant in amplitude, but varies in frequency at (usually) an audio rate.

The variation in frequency can be brought about by either electrical or mechanical means, the simplest mechanical type being a motor-driven variable capacitor which is placed across the oscillator tuning circuit. In other instruments, the frequency modulation is accomplished by means of either a reactance valve or a section of ferri material in the oscillator coil whose effective permeability is varied by A passing through a supplementary winding.

"X" TRACE

In use the AF voltage or current used to vary the frequency of the oscillator is also connected to the horizontal X plates of an oscilloscope to deflect the CRT spot, so forming a line. Points along this line then represent frequencies, rather than times, as they would on the X trace of a normal CRO.

Fig. 1 shows in block diagram the set up for aligning a receiver by means of a wobbulator.

The frequency modulated signal from the wobbulator is applied to the input of the receiver so that it sweeps across the passband. The output from the receiver's built-in detector circuits, or from a separate demodulator probe, is displayed as Y axis deflection on the oscilloscope. At the same time the wobbulator sweep frequency is connected to the X plates of the CRO, so that distances along the horizontal axis of the display are a function of oscillator frequency.

Distances along the vertical axis of the display will be proportional to the output of the receiver, indicating the gain or response. The trace thus represents a curve of the gain/frequency characteristic of the receiver.

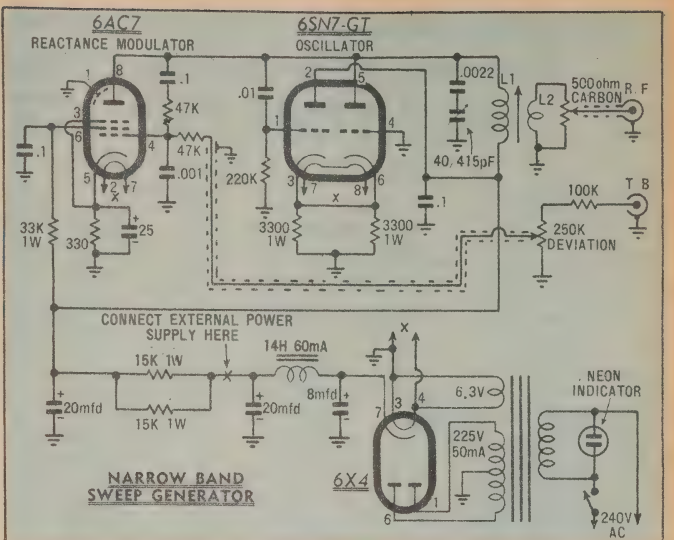
This displayed response curve is very informative, because it shows instantly the effect on the receiver passband of any adjustment made to the tuned circuits.

SWEEP RATE

In commercial units designed for TV service work it is common practice to use the 50-cycle mains to provide the sweep frequency for the wobbulator. While this is simple and convenient, it has certain disadvantages when applied to narrow band filters, such as the generator is designed for.

When sweeping any circuit, it is essential that the sweep rate be low enough to allow the voltages in the circuit to reach their full amplitude at each

y instant of time. If this point is
red, serious errors can occur.
the event of the sweep rate being
high there will not be sufficient time
the voltages in the circuit to reach
normal maximum value and the
nt" of the response curve displayed
have a lower amplitude than the
al response curve.
onversely, after the frequency of the
p generator has swept past the top



Circuit diagram of the complete sweep generator. The relatively few parts involved and the use of ex-disposals valves makes it a relatively inexpensive instrument.

Transformer — 225/225 volts, 50mA—6.3 volts, 1.8 amps.
Choke 14 henries at 60mA.
Single-gang broadcast type tuning capacitor.
10/1 reduction vernier drive.
Octal sockets.
7-pin miniature socket.
250K potentiometer, linear law.
500 ohm carbon potentiometer.
6X4 valve.
6AC7 valve.
6SN7 valve.
single pole single throw switch.
240 volt neon indicator light.
Co-ax sockets and plugs.
suitable case and chassis, instrument scale assembly, plain and shielded wire, rubber grommets, etc.

RESISTORS

330 ohm 1 watt
3000 ohm 1 watt
15K 1 watt
47K ½ watt
100K ½ watt
220K ½ watt

CAPACITORS

1 .001 400 volts working
1 .002 400 volts working plastic
1 .01 400 volts working plastic
3 .1 400 volts working
1 25mfd 25 volts working
1 8mfd 450 volts working
2 20mfd 300 volts working

he passband, there will still be some
ut as the circuits return slowly to
no-signal condition.
ken together, these effects produce
apparent increase in bandwidth, a
acement of the displayed response
e in the direction of the sweep, and
symmetrical response curve with the
ing edge stretched out more than
leading edge.
extreme cases a damped oscillation
be produced after the trailing edge
he response curve.
order to minimise these problems,
important that the deviation control
uld be set as low as possible when
g sweep units which use the 50-cycle
ns as a sweep voltage. Restricting
amount of deviation reduces the rate
which any given frequency segment
aversed.

WTOOTH

far better method for our purpose
use a sawtooth waveform for the
p voltage and an examination of
2 readily shows why. Here we have
0-cycle sine wave compared with a
ycle sawtooth waveform. The solid
ion of each waveform denotes that
which actually sweeps the signal
ss the receiver's passband; the dot-
portion is the retrace.
effect, the sawtooth waveform
ps at a rate only half that of the
wave while the retrace, which is
portant to the displayed response
e, is kept to a minimum.
further benefit to be derived from
use of a sawtooth waveform as a
p voltage is in the "linearity" of
the sweep in terms of time versus amplitude. A further examination of Fig. 2 will show why this is so. With the sine wave, the sweep would be fast at the beginning where the waveform rises quickly in amplitude, slow across the middle where the amplitude is fairly constant, and fast again at the end where it drops rapidly in amplitude.

With a perfect sawtooth waveform, on the other hand, the sweep rate is constant over the entire range.

Because it is necessary to use a CRO to display the response curve under analysis and because it seems fair to assume that such a CRO would have a sawtooth timebase oscillator of reasonable quality, why not borrow some of this sawtooth waveform to sweep the generator?

By so doing two distinct advantages are realised: (1) It is not necessary to connect the sweep voltage to the X plates of the CRO—it's already there—and (2) the frequency of the waveform can be varied so obviating any tendency toward too fast a sweep rate.

The generator is based on the fact that such a waveform will be available from the CRO and the assumption keeps the number of valves and components down to a minimum. Excluding the power supply, which is optional, there are only two valves in the operating circuits.

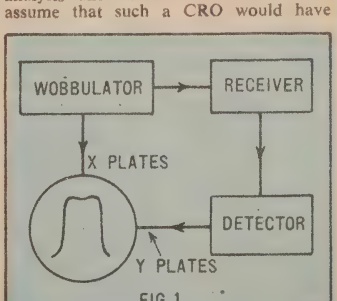


FIG. 1

This block diagram of a sweep alignment set-up will serve to illustrate the connection between the various pieces of equipment involved. The detector shown in block may be an integral part of the receiver.

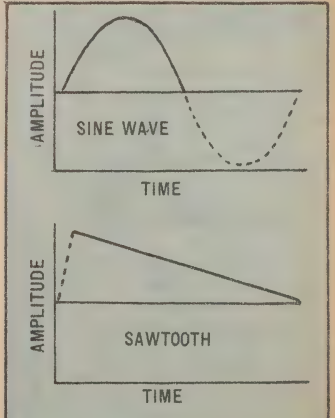


FIG. 2

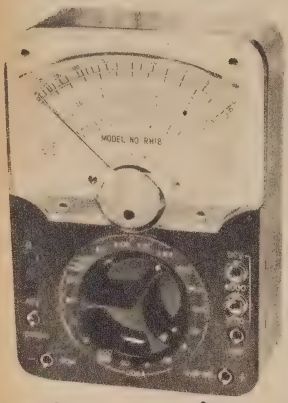
These graphs illustrate the difference between the sweep rates of a 50 cycle sine wave and a sawtooth waveform of the same frequency. The part shown in dotted lines is used for retrace of the beam.

Beautifully Finished and Highly Sensitive

MULTIMETER TESTERS

EXCLUSIVE TO RADIO HOUSE PTY. LTD.

(Handy Size)



MODEL RH18

MODEL RH-18

* Up-to-date design
* High sensitivity-20,000 Ohm/V DC 10,000 Ohm/V AC
* Rugged construction—clear plastic panel and moulded case
* Wide measuring ranges

SPECIFICATIONS

DC Voltages: 0-6-30-120-600-1200-6000V (20,000 Ohms/V)
AC Voltages: 0-6-30-120-600-1200V (10,000 Ohms/V)
DC Current: 0.60 uA, 0-6-60-600mA, 12A
Resistance: 0-5K-500K, 0-5Meg-50Meg (30 Ohms, 3K, 30K, 300K at centre scale)
Decibels: minus 20db to plus 63db in 5 ranges
Dimensions: (3 5-16" x 6 5-16" x 2¾")
Weight: (29oz approx.).
Batteries: Penlight 1.5V x1 and 15Vx1, testing leads with prods.

PRICE £13/15/-

Including Sales Tax.

MODEL RH-5

MODEL RH-5

* High sensitivity-20,000 Ohms/V DC 10,000 Ohms/V AC
* 3" Meter
* Handy pocketable size

SPECIFICATIONS

DC Voltages: 0-10-50-250-500-1000V (20,000 Ohms/V)
AC Voltages: 0-10-50-250-500-1000V (10,000 Ohms/V)
DC Current: 0-50uA, 0-5-50-500mA
Resistance: 0-10K, 0-100K, 0-1Meg, 0-10 Meg (62 Ohms, 620 Ohms, 6.2K, 62K at centre scale)
Capacitance: 0.0001uF-0.005uF 0.005uF-0.1uF
Decibels: minus 20db to plus 36db in 2 ranges
Dimensions: (3½" x 5¼" x 1¾")
Weight: (15oz approx.)
Complete with internal battery, testing leads with prods.

PRICE £9

Including Sales Tax.

TRANSISTOR TAPE RECORDER

Model 201 Minipex,
Dimensions: 5¾in x 3¾in x 1¾in. Fits into a pocket.
Priced **£15/15/-**
Complete with earphone and Mike combined
Fitted with batteries. Standard Torch Cell and 9 Volts Transistor Battery No. 216. Recording Time 9 minutes. 60ft full Track Tape Standard recording Tape used 200ft for 9/6, enough to fill the supply reel 3 times. Spare reels available. Variable Speed Control. Erases Automatically as it records. Freq. response 300cps to 4000cps. Weight Approx. 1lb. Battery life: 5 hours Standard Cell, 80 hours Type 216.

Speaker Unit with Volume Control
Price: £4/-/-.
Size: 3in x 4in.

MODEL RH-31

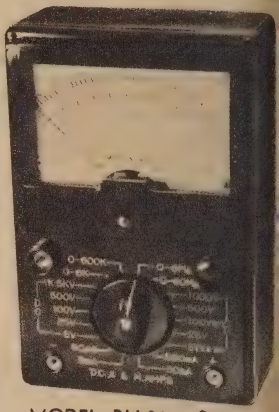
* 20,000 Ohms per Volt on DC
* 10,000 Ohms per Volt on AC
* 3½" Meter
* 18 position selector

SPECIFICATIONS

DC Voltages: 0-5-25-100-500-1000-5000 (20,000 Ohms/V)
AC Voltages: 0-5-25-100-500-1000V (10,000 Ohms/Volt)
DC Current:. 0-50 uA, 0-5-50-500mA
Resistance: 0-6K-600K, 0-6Meg-60Meg (30 Ohms, 3K, 30K, 440K at centre scale)
Capacitance: 100uuF--0.01uF, 0.002uF-0.3uF
Inductance: 20 H to 2000 H
Decibels: minus 20db to plus 30db in 2 ranges
Output Jack: for Audio measurements
Dimensions: (3¾" x 5¾" x 2 3-8")
Weight: (23oz approx.)
Complete with internal battery and testing leads with prods.

PRICE £10/12/6

Including Sales Tax.



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oming now to the main circuit we see that the sawtooth waveform is into the grid of a 6AC7, which acts reactance tube modulator, varying frequency of the 6SN7 oscillator e.

he operation of this reactance valve uite interesting and might bear some xanation before proceeding further the circuit.

he reactance valve is usually a high sconductance pentode, or other multi- type, with its plate connected to the llator tuned circuit. Energy from the d circuit is fed back from plate to through a network which changes phase of the feedback voltage at the evant frequency by about 90 degrees.

ASE DIFFERENCE

his out-of-phase feedback component es the plate voltage and plate cur- to exhibit a phase difference, the ent lagging or leading the voltage about 90 degrees, according to the ngement of the feedback network.

his artificial voltage and current ponent, coupled across the tuned cir- u makes it behave as if, in fact, in- uance or capacitance had been added, reby changing the resonant frequency the output frequency of the asso- ed oscillator circuit.

he order of this reactive effect is endant on the gain of the reactance e, and therefore on its transconduc- nce and plate current. If these last are ed by means of grid potential the ency of the oscillator circuit will kwise change.

DC shift will produce a long term nge. Alternatively, the grid potential e be varied in cyclic fashion (as with ul sawtooth oscillator) to produce a ency modulation effect.

o further illustrate the action of this le, reference to Fig. 3 together with following detailed explanation of the uitry involved will help to follow the eral principles more clearly.

he oscillator could be any ordinary pe whose frequency is determined pre- minantly by the tuned circuit compon- nt L and C. However, connected right oss the two is the plate circuit of the tance control tube.

he oscillator voltage appearing across nd C is coupled by C1 to the plate he control tube. If the circuitry were o nd here, this would merely cause a nl in-phase current to flow through ne control tube and the only effect ould be that the oscillator tuning com- nents L and C would be damped by nedynamic plate resistance of the re- ance valve.

REACTANCE HIGH

point of fact, however, some of the nge present at the plate by reason of s fed to the number one grid of the ntrol tube through capacitor C2. In ctice, this last is made small in cap- ance for its reactance to be high pared with the value of R.

s a result of this relationship, a ne of phase rotation effects becomes ent. Firstly because the network C2, capacitive, current through it leads e voltage by approximately 90 degrees. wever the voltage across R1 alone, ing a pure resistor, must be in phase h the leading current. Therefore, the nge to the number one grid must lead the plate voltage by approximately 90 degrees.

The valve plate current will tend to vary in sympathy with the grid voltage, which means that two separate influences will be at work on the plate current:

(1) It will tend to vary in phase with the plate voltage because of the natural dynamic plate resistance of the valve and;

(2) It will have a component displaced approximately 90 degrees by reason of the leading voltage supplied to the grid through C2 and R.

With a valve having a high dynamic plate resistance the in-phase component is likely to be very small, which means that the valve merely appears to the tuned circuit as a device in which the current leads the applied voltage by approximately 90 degrees.

It behaves, therefore, as additional capacitance in parallel with C.

The value of this apparent capacitor will obviously depend on the amount of plate current change effected by the "quadrature" or phase displaced signal on the grid. It is therefore a function of the gain of the reactance valve and can be related to its transconductance, its standing plate current and the voltages applied to various electrodes — in particular to the input control grid.

Normal practice is to adjust the oscillator to the desired centre frequency by means of L and/or C, and with the plate current, transconductance and gain of the reactance valve at some intermediate value.

By now applying a sawtooth or other cyclic waveform to the controlling grid, its shunt capacitive effect will appear to vary at an audio rate so that the output from the oscillator will be frequency modulated.

CAPACITIVE SHIFT

The quadrature network (C2, R) shown in Fig 3 is only one of several possible arrangements. Reversing their position changes the phase relationships and makes the valve appear as additional inductance. Alternatively, C2 may be replaced in circuit by a selected value of inductor, making the reactance valve appear as either an inductor or capacitator, according to the position relative to R.

In our prototype model we used a reactance valve circuit with a capacitive shift similar to that shown in Fig. 3. However, this produced rather severe non-linearity in the sweep and subsequently the circuit was changed to that shown in the main circuit diagram. This arrangement, which produces an inductive shift effect, was found to produce much better linearity with the various oscillator coils tried in the circuit.

The oscillater circuit is of the "two terminal" type in which oscillation is produced with a single winding coil by virtue of the .01 capacitor connected from the plate of one triode to the grid

This basic circuit of a reactance valve modulator is tied in with the detailed explanation given in the text of the article. Changing the network involving C2 and R will change the shift from capacitive to inductive — a step taken in the complete instrument.

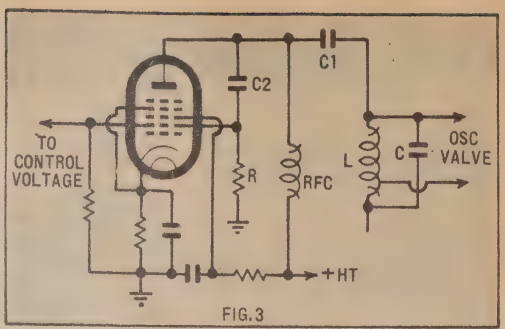

FIG.3

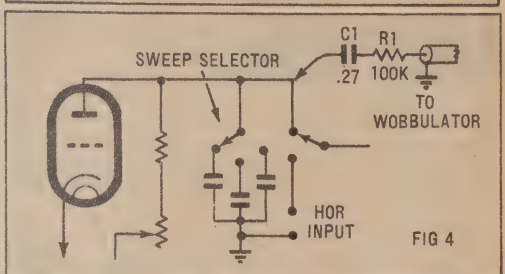

FIG 4

This is one method of connecting the sweep generator to the time base of the oscilloscope. It may be possible to fit an extra terminal to the CRO front panel and include C1 and R1 permanently in the circuit.

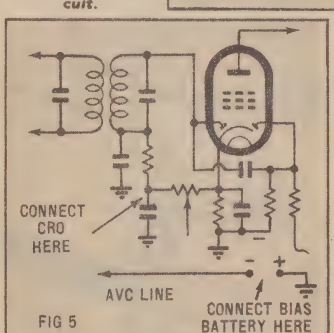

FIG 5

This typical circuit of a second detector and AVC system will serve as a guide when connecting up the vertical amplifier of the CRO and disabling the AVC line.

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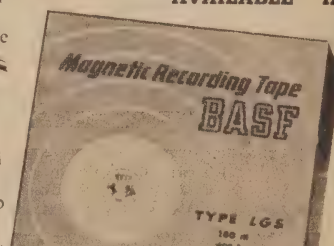

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the other and the unbypassed common node resistor.

This particular circuit was selected so t a standard IF transformer could be d as the oscillator coil. It also has the antage that it is particularly stable in far as frequency drift is concerned, important point when the alignment narrow band filters is to be under- en.

Tuning of the oscillator is by means a miniature broadcast type tuning pacitor which has a .002 capacitor in ies with it. The .002 is only to late the DC voltage from the fixed tes of the capacitor and prevent the sibility of a short on the HT line, uld these plates accidentally touch.

DUCTION DRIVE

To facilitate tuning a 10 to 1 re- tion drive is used between the cap- tor and the tuning knob. A 4 by 3 h dial together with a pointer takes e of calibration problems. While this l has been shown uncalibrated in the otograph of the completed unit, it is visaged that some calibrations covering range of coils will be added at a later te.

The coil is, as mentioned earlier, ply the winding from a standard 5Kc IF transformer. The parallel tun- capacitors connected internally oss each winding should be removed d about 80 per cent of the turns re- ved from the winding which becomes

If it should be felt desirable to wind a coil rather than modify an existing nsformer, such a coil can easily be nstructed on a F4021/Q1 toroid by nding on 64 turns of 24 B and S aelled wire for L1 and 2 turns of e same wire for L2.

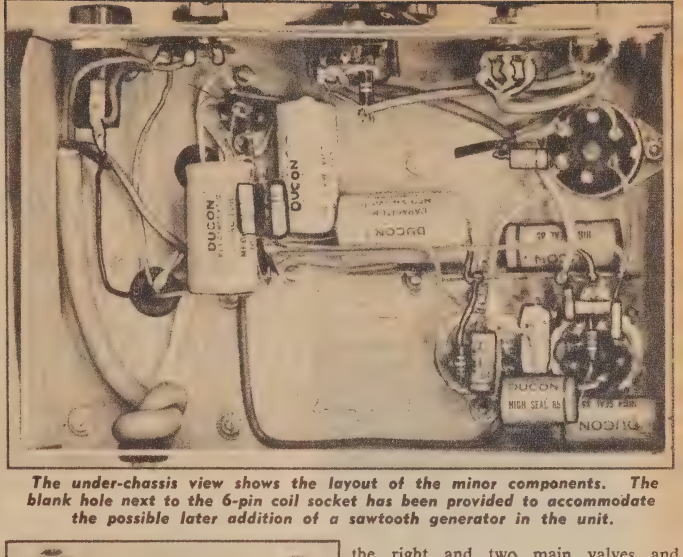
A toroid wound to these specifications d two different brands of IF trans- rmers were tried in the prototype unit d all produced identical results.

In our case the coil has been mounted a 6-pin coil former base and plugged to a socket. While this may not be rictly necessary, it was felt that it uld be highly desirable where it was eded to cover more than one IF annel. Not all receivers have 450Kc "s; in fact a number of receivers rrently in use have IF channels as high 2.0 Mc. By the use of the plug-in stem the generator can be made to ver any frequency one desires merely inserting the appropriate coil.

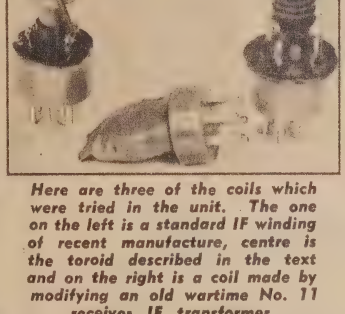
LUG IN COILS

A further use for the plug-in coil stem would be in the alignment of high equency crystal lattice filters. Quite a mber of commercial units use these ters on frequencies around 5Mc and increasing number of amateurs are nstructing their own filters on these equencies because of the relative cheap- ss and availability of crystals on these annels.

No apologies are made for the use of e older type valves as the oscillator id reactance modulator. If desired, a 3X6 may be substituted for the 6AC7 id a 12AU7 for the 6SN7 but the pes used should be readily available om the average box of spares. It might e mentioned that there is absolutely no egradation of performance by the use these valves, the 6AC7 being a particularly suitable type for the reactance modulator valve.



The under-chassis view shows the layout of the minor components. The blank hole next to the 6-pin coil socket has been provided to accommodate the possible later addition of a sawtooth generator in the unit.



Here are three of the coils which were tried in the unit. The one on the left is a standard IF winding of recent manufacture, centre is the toroid described in the text and on the right is a coil made by modifying an old wartime No. 11 receiver IF transformer.

The power supply is perfectly conventional and no explanation is thought necessary except to say that, if desired, power to feed the unit may quite easily be taken from the receiver under alignment. If this is done, the connection should be made at the point marked X on the circuit.

Connection at this point will give decoupling from the receiver circuits as well as additional filtering provided by the 20mfd capacitor. This filtering will be found absolutely necessary, as it is important that the carrier generated by the oscillator valve should not contain any hum modulation.

The instrument is constructed on a standard aluminium chassis measuring 8 by 5¼ by 2 1/8in, which fits nicely into a standard instrument case measuring 9 by 6¼ by 5¼in. The front panel measures 9 by 6¼in.

Placement of the various components can be seen from the photograph showing the rear view of the unit. The tuning capacitor with its reduction drive can be seen in the centre of the chassis, with the power supply components to the right and two main valves and tuning coil on the left.

It will be noticed that there is a blank hole behind the tuning gang. This space was originally occupied by the coil to bring it as close as possible to the tuning gang, but it was found that the transformer was inducing a certain amount of hum into the coil. It was subsequently moved to the position which it now occupies.

While it would have been possible for us to have our artist touch up the photograph so that this hole was not visible, it has instead been left as a reminder to others who, in differing from our original layout, may tend to make the same mistake.

LAYOUT

Lavout of the front panel and controls can be seen from the photograph showing the unit in its case. The deviation control is equipped with an instrument-type knob which has graduations from 1 to 10. This is necessary in order that one may set the control fairly accurately for any desired degree of deviation.

The two co-ax sockets on the right of the front panel take care of the input from the time base of the CRO and the RF output from the generator.

A power switch and 240 volt neon indicator light are included and can be seen at the bottom left of the panel.

The under-chassis view shows the layout of the minor components. There are very few of them, in point of fact, and, excluding the power supply, which may be optional, there are only seven capacitors and nine resistors in the circuit.

The spare 5/8in hole alongside the coil socket and the blank lugs on the tag strip near the oscillator and reactance valves have been provided to allow the possible inclusion of some form of sawtooth generator into the unit at a later date.

Shielded wire has been used to couple the deviation control and the output attenuator to their respective positions in the circuit. This is necessary to prevent any possibility of stray hum entering these circuits.

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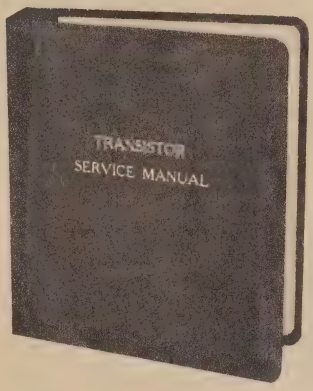

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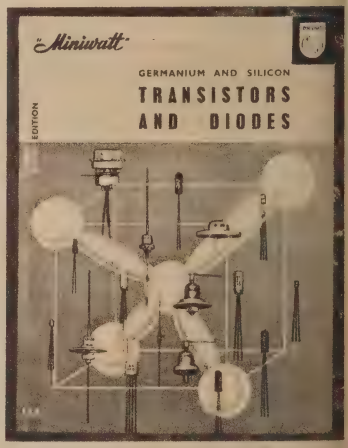

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Coming now to the actual use of the nit, the first thing is to obtain some f that sawtooth waveform which, as we ıentioned earlier, can be taken from ıe time base of the CRO.

A number of instruments have direct onnections from the plates of the athode ray tube brought out to term-ıals either at the front or rear of the ıstrument. Where this has been done, is only necessary to make connection) one of the horizontal or "X" plates ırough a .27 capacitor.

CRO "X" PLATES

If, however, your CRO should be of ıe type which does not have this faci-ty, it will be necessary to remove the ıstrument from its case and make direct ɔnnection to the time base or one of ıe X plates. Fig. 4 shows how this can e achieved in a typical instrument. The ıpacitor C1 is used to isolate the wob-ılator from the DC voltage present at ıe plate of the 884, while the resistor 1 minimises the loading of the time ase circuit by the capacitance of the ɔ-ax cable.

Having obtained the sawtooth wave ɔrm, the next step is to connect the F output co-ax to the input of the rcuit to be swept. Because this output at a low impedance, care should be ken not to connect it in such a fashion at undue loading is imposed on any the circuits whose response we wish see displayed on our CRO screen. this point is not watched, a com-etely distorted curve will be presented r our inspection and any adjustments hich are made in order to correct it ill only lead to serious misalignment the receiver.

One simple way of connecting into e receiver is to disable the oscillator ction of the mixer valve and connect to the cathode circuit through a .1mfd pacitor. If this should prove imprac-:able, the unit can be connected rough a resistor of 100K ohms directly to the grid of the mixer valve, where e valve itself will help to remove any fect of loading on the following cir-uits.

Possibly the simplest and most effi-ent coupling method of all is to wind 6 turn link around the glass envelope the mixer valve and connect the RF ıtput of the generator directly to this. ıis method is common practice in TV ignment and imposes no load on the ned circuits whatsoever.

As mentioned earlier, the signal must detected before being presented to e vertical or "Y" plates of the CRO. s the receiver will probably contain diode type second detector, the con-ction can be made somewhere across e diode load resistor as shown in g. 5.

)EMODULATOR

If the receiver is of the type designed ırely for single sideband use, it may equipped with only a product detector d it will be necessary to use a modulator probe similar to that shown Fig. 6. This probe is of the shunt ɔde type.

In order that the AVC system of the ceiver should not have any effect on e displayed response curve, it will be cessary to disable it in some way. ıther than simply short the AVC line earth and so run the risk of over-ıding the circuits, it is advisable to connect a bias battery to the AVC line of a voltage similar to that normally encountered on the line with a signal of average level. The positive terminal should be connected to ground and the negative connected to the point shown in Fig. 3. In many receivers, this can be simply taken care of by setting the manual/AVC switch and controlling the gain with the RF gain control.

The unit which we have described has a maximum deviation of around 25 Kc, though not all of this is usable. There will be some distortion of the displayed response curve if the deviation control is set to deviate any more than about 12 Kc overall. This is no problem when we are aligning narrow band filters, as the maximum deviation required is between 8 and 10 Kc. Care should be taken when setting this control that only sufficient deviation is applied so that the bottom, or skirt, of the response occupies almost the entire base line.

RESPONSE CURVE

It is advisable when adjusting tuned circuits by the sweep method, to proceed in a methodical and careful fashion. The technique is more of the "gently, gently catchee monkey" style than a haphazard twiddling of trimmers.

It is often of benefit first to align the circuits for maximum amplitude and then proceed to note (on paper if necessary) the effect of each individual adjustment to the tuned circuits. Using this method, it is possible to find which trimmers cause a peak on the right hand side of the response curve and which cause a peak on the left. By suitable adjustment of the correct trimmers, the desired flat-topped steep sided response curve can be obtained.

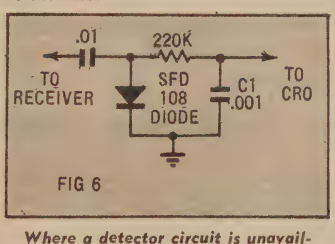

FIG 6

Where a detector circuit is unavailable in the receiver this demodulator probe can be used. If any RF is still visible on the trace, the value of C1 should be increased.

In practice, it is seldom possible to obtain an exact flat top, though in the filter described last month, the valleys between peaks are only 2db and hardly worth mention.

Where it is desired to align wide band circuits requiring more than 10 Kc deviation, the following method may be used.

Set the sweep generator oscillator to a frequency around 400 Kc and tune the receiver front end to the third harmonic which will be around 1200 Kc. By multiplying the frequency three times, we will automatically be multiplying the deviation three times. In other words, we now have available 30 Kc of effective deviation. This amount should prove ample to align most wide band AM tuners. In fact, the method was used in our own laboratory to align the "Unit Program Source" described in last month's issue.

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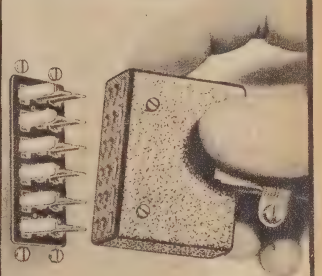

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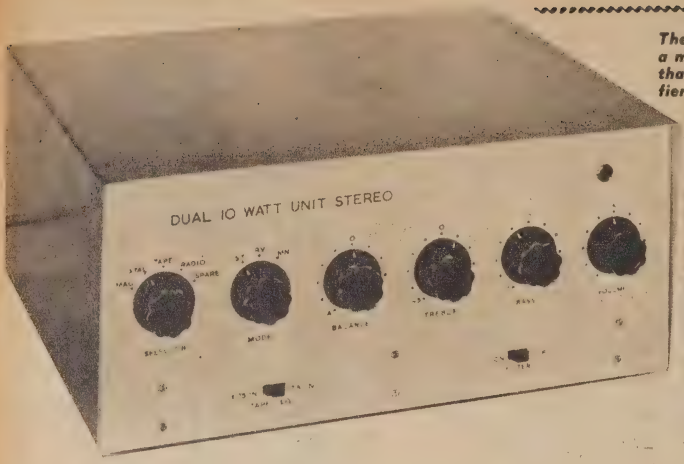


The completed amplifier is housed in a metal case larger than, but similar to, that used for the previous Unit amplifiers. Six controls and two switches provide great versatility.

Versatile 2x10w. Stereo Amplifier

Here is a unit stereo amplifier designed to combine moderate power capability with versatility. It has input facilities for five separate stereo signal sources, in-built magnetic pickup and tape head pre-amplifiers, and an output for a third or "middle" speaker. Full tone control facilities are provided to enable it to handle a variety of "Hi-Fi" applications.

By JAMIESON ROWE

ACTUALLY, this amplifier started off as an idea for the author's personal stereo setup. I wanted a stereo amplifier having a moderate power rating — not high powered, but capable of dealing with larger-than-normal rooms and small halls. I wanted it as a unit amplifier, too, because it means only one compact unit to carry from place to place (or sit on a shelf in the loungeroom).

Since there just didn't seem to be anything available commercially made to suit my needs or pocket, I had to develop and make up one myself!

SUITS MANY NEEDS

Since, to judge from some of our readers' letters lately, it seems likely that a number of readers have stereo requirements similar to my own, we are presenting full details of the final amplifier in these pages. It should fill the need for a many-purpose stereo unit amplifier. Even if not suitable in its entirety, it may serve as a basic guide for a somewhat less complicated amplifier.

Before we start, however, let's face it, the amplifier isn't simple. It can't be, because a simple amplifier just won't do the job we want. It won't be cheap to build for the same reason, although much cheaper than an equivalent commercially-made unit.

Again, we would suggest that it should not be attempted by a beginner to electronic construction. Apart from the sheer cost and complexity of the design, there are many points of layout and construction which will only be known by the experienced amplifier constructor.

While we will try to give as much information as possible for the successful construction of the amplifier, inevitably there will be points not mentioned due to oversight or to sheer lack to space, so beginners would be well advised to postpone construction pending more experience.

Now that we have made this point clear, we can pass on to the description of the amplifier, and the reasons behind the final design.

Firstly, perhaps a few words on the matter of power output would be in order. A stereo amplifier with nominal 10 watt per channel power rating, as we have proved in the past, has plenty to commend it. With sensitive, modern loudspeakers, an amplifier of this type can provide ample volume for all domestic applications, as well as for small halls, churches, etc.

In a typical domestic setting, such amplifier will perform very well, hav a good power reserve and consequ low peak distortion. It also provides good compromise between a smal amplifier having twin single-ended o put stages and a more expensive hi power setup with its attendant cost a heavy power supply components.

The amplifier shown on these page accordingly designed to have a nomi 10 watt per channel rating, although prototype delivers a little more than watts per channel before serious ov load distortion occurs.

Now for the matter of tone contr In the past, with our amplifiers a control units, we have generally us separate bass and treble controls in except the smallest units. For an amp fier intended for serious reproduction music, the provision of separate, co tinuously variable controls is a virtu necessity. It enables signals of quite d fering tonal characteristics to be adju ed at both the upper and lower f quency ends of the spectrum for b anced reproduction.

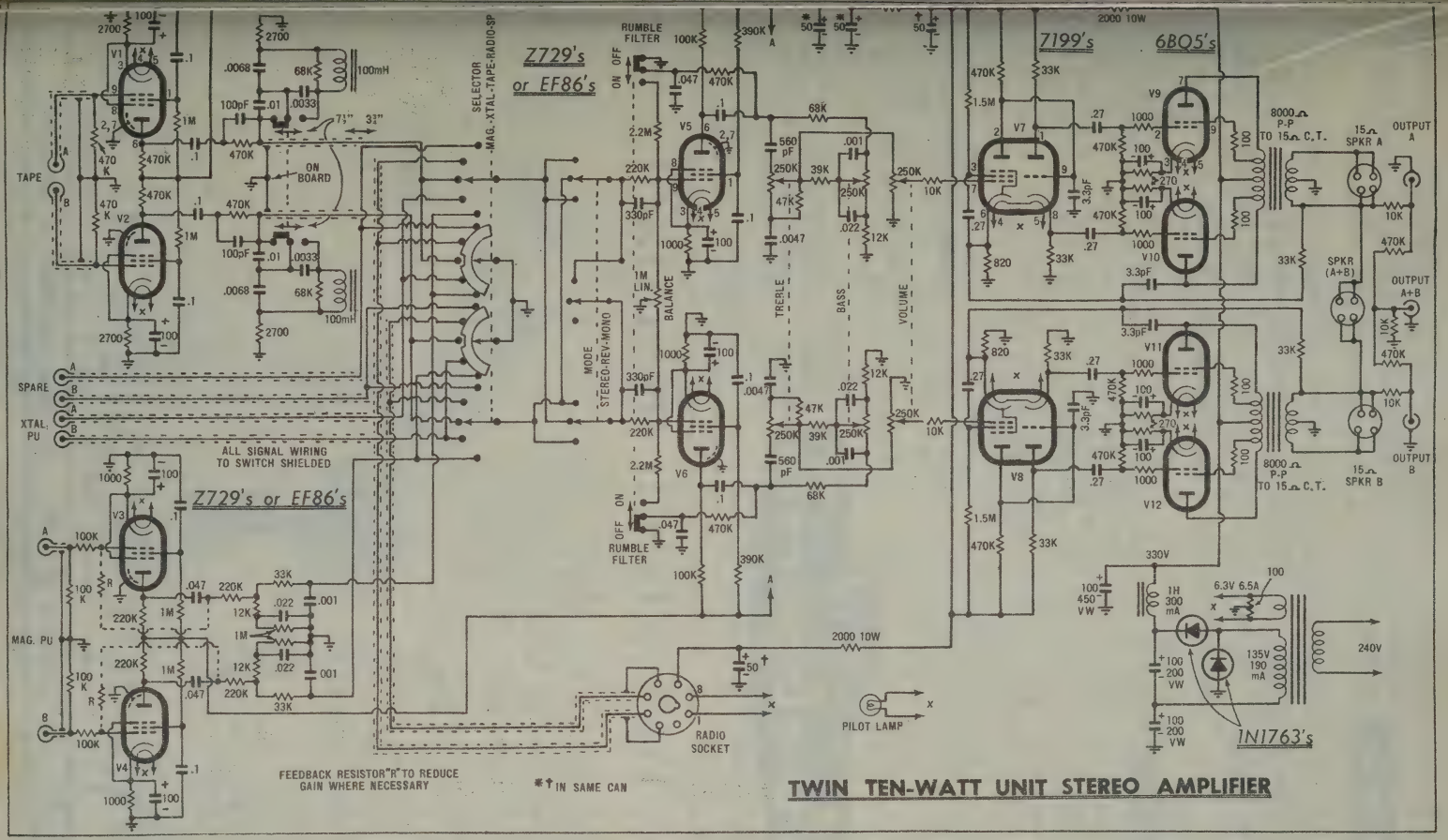
For suitable control of tonal balan the controls should be able to boost cut the amplifier response by an amou equal to about 3 times (or 10 decibe at both limits of audibility. This is do by the controls and circuitry in the u shown, which employs a basic tone co trol circuit as used in previous cont units. This amount of boosting and tenuation is available, even though t full facility is rarely required in pra tice — fortunately!

INPUT SELECTION

A matter of vital importance to amplifier of this type is the selection input facilities and provision of pr amplification and equalisation for lo level inputs.

An input facility which may be r garded as almost essential is that f a crystal gramophone pickup. This because such pickups are the most co mon of all types, mainly due to th low cost. Fortunately, the relatively hi output inherent in such types makes t provision easy since no special pr amplification is required. The electric signal from such a pickup when repr ducing a standard recording is al "flat" tonally, so that it requires special amplifier frequency compe sation.

Signals which also come under t classification of relatively high outp



Here is the circuit for the complete amplifier. Note the use of a switch having earthing plates at the rear of each section to earth all signals not selected for amplification, to prevent crosstalk from marring reproduction. Readers should also note that the circuit may be built without the dual tape pre-amplifiers by merely omitting the valves and circuitry concerned. Thus readers who feel that the extra components are not really required for their application may build a smaller and less costly amplifier using the same basic design. The provision for a third speaker is made by earthing the centre tap of both output transformer secondaries.

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Features: Twin 10w amplifiers, stereo pre amps, treble, bass, loudness, balance and function controls, inputs for magnetic and ceramic cartridges, tape and tuner. Quality at the low price.
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TYPE 72 PENCIL MICROPHONE

- Australian made for Australian conditions.
- Robust Dynamic Insert.
- Excellent frequency response.
- Stand or hand operation with quick release from clamp.
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TECHNICAL DETAILS

FREQ. RANGE 50 to 15,000 CPS
OUTPUT—50db Odb-1volt/dyne/CM2
IMPEDANCE 50 ohms
FINISH Grey and Satin Chrome
SIZE: 1⅛inch Front O.D. to 1⅝inch Rear O.D. by 7½ inches Long.
CONNECTION. Locking 3 pin Cannon
SWIVEL. 5/8 inch 26 T.P.I. to 1¼ inch slotted clamp.

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l tonally balanced are those from io tuners, FM tuners, television re- vers and pre-equalised audio equip- nt. These also become relatively easy amplify. In the unit presented in these es, we have allowed for connection both crystal pickups and radio tuners, addition to a pair of input sockets rked "Spare," and suitable for con- tion to any of the above-mentioned ipment.

There are other common sources of nals, however, that do not come under classification. One is a magnetic mophone pickup, which has a re- vely low output signal voltage, re- ring considerable pre-amplification in er to build it up to the level of cry- pickups. It also has an output which not tonally balanced, but decreases ghly as a linear function of fre- ncy, meaning that frequency com- sation or "equalisation" must be in- ded in the pre-amplifier circuitry to ain balanced reproduction.

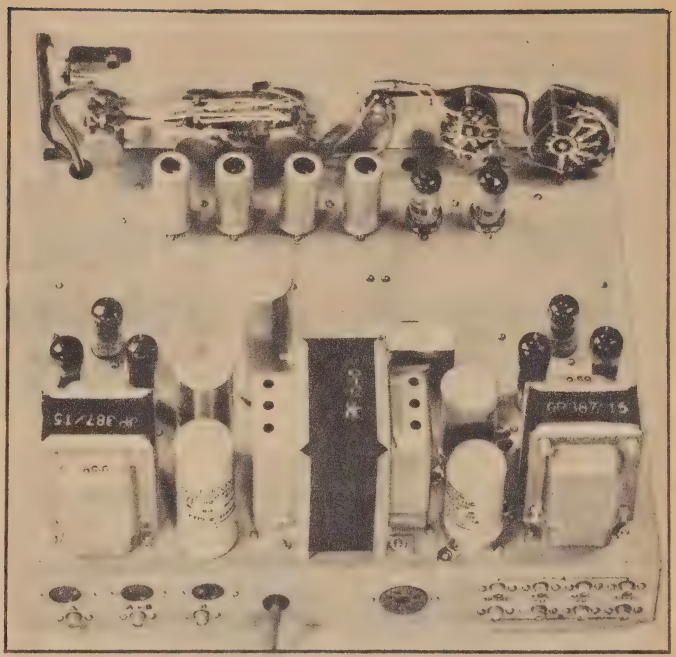
POPULAR

ince these pickups are quite popular ong people interested in the highest lity audio reproduction from records, s very desirable that an amplifier de- ned for "Hi-Fi" use have facilities for amplification of signals from them. the case of the present amplifier, for ance, we have included the necessary amplifier valves and equalisation cir- ry required, since the amplifier was eloped with versatility in mind.

agnetic tape recorder heads, which also quite commonly used in high lity audio systems as a source of sig- require roughly similar treatment. y too have low output voltage, and output which diminishes with fre- ncy. However, the amplitude-fre- ncy characteristic differs subsantially n a magnetic gramophone pickup, accordingly requires quite different alisation. Thus it is necessary to pro- , in the interests of quality and ver- ity, separate tape preamplification uitry if it is desired to provide tape oduction.

the present circuit, it was desired provide this facility, to enable pre- rded tapes to be reproduced easily without the need for a full tape re- cling and replay adapter or unit. For ers who feel that they would rather complete recording and replay faci- s, we suggest that the tape pre- ifiers may be left out, and a dual rding and replay unit built.

owever, it is the intention of the or to develop in the not-too-distant re a stereo tape recording adapter



This view of the rear and top of the chassis gives a good idea of the layout of the major components. Note the four pairs of input connectors at the lower right, and the three pairs of output sockets at the lower left. The octal socket is used for radio tuners and other signal sources requiring power.

for the present amplifier, to provide the missing feature. This, the author feels, is the best answer to the problem. It enables the builder of the present unit to play pre-recorded mono and stereo tapes without rendering the basic unit inordinately complicated. The recording section, which many may not require anyway, may be added as an adapter at a later date.

Obviously, the complete tape amplification circuitry may be left out by the reader if cost is at a premium, or if the feature is not felt to be necessary.

Now for the question of output facilities. In addition to the normal output socket from each channel used for connection to each loudspeaker, many audio enthusiasts feel that a third or composite output socket should be provided. This is for connection to a third loudspeaker placed midway between the original two, to fill in the acoustic "hole in the middle" sometimes experienced.

The signal required for the third speaker is, in fact, a signal made from the sum of both channel signals. An easy way to provide such a signal is to arrange that the output transformer secondaries of each channel may be wired to allow a speaker to be connected in a circuit containing part of each winding. If the phasing of windings is carried out correctly, a current will flow in the third speaker due to the combined effect of each channel signal.

As the circuit shows we have included this feature in the present circuit as it may be fitted at very little cost, namely that of an extra socket.

In addition, you may notice the provision of three additional output connectors, providing low-power output voltages from each channel in addition

his close-up of the rear of the control panel shows the wiring around the controls. Note the use of a four-lug gstrip between the treble and bass controls to support the insulated "earth" connection and to terminate the shielded leads bringing the signals from beneath the chassis.

Here at last! By popular demand!

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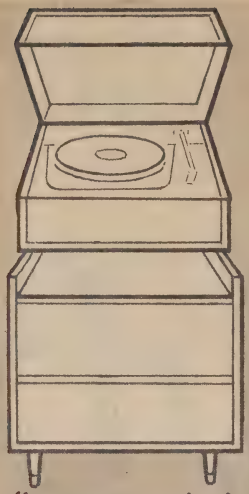

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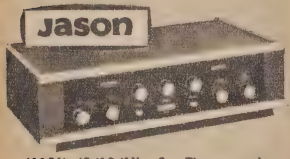
Top section for turntable available separately, makes perfect housing for all types, including transcription models. £10/10/-. Add bottom if required, £10/10/-

MASTERSOUND TRIO W-7. Complete shelf-mounting stereo amplifier with built-in stereo radio, including short wave. Twin 5-watt audio channels give crystal-clear, full-bodied Stereophonic Sound. Cash price, £63 complete. Unbeatable buy!



JASON J2/10/Mk. 3. The connoisseur's choice for record reproduction. SHELF-MOUNTING twin ultra-linear output stages give high-powered distortionless sound. Ten watts per channel. Inbuilt pre-amp. for magnetic pickup, tape, etc. 89 guineas.

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) a composite low-output voltage. hese outputs are fitted to allow easy onnection of external audio equipment the outputs of the amplifier. External ereo amplifiers or tape recorders may e connected to the two stereo outputs addition to the speakers, or mono- ionic equipment connected to the com- osite output connector.

While this may appear to be merely plication of output sockets with the ided cost of five resistors, it is included r the reason that it enables low power onnections to be made correctly and ickly, without fiddling with temporary onnections and wires twisted around oice coil terminals, etc.

OPERATION

Now let us turn to the actual circuit r a brief look at its operation. Firstly, e input circuits will claim our atten- on.

The stereo tape pre-amplifiers, using 1 and V2 which are Z729/EF86 alves, are essentially the same as that veloped for the "Playmaster Tape dapter" of January, 1961. A slider witch is used to alter the compensation aracteristics to match tape speeds of 75 and 7.5 inches per second, and gh-frequency peaking may be altered frequency to suit the particular head it used, by adjustment of the slugs in e inductors.

These tape pre-amplifiers and their as- ciated equalisation circuitry are de- gned to provide substantially .A.R.T.B. or C.C.I.R. playback equali- tion to the tape signal, which means at pre-recorded tapes may be played ithfully through the system.

Below these in the circuit are the two agnetic pickup pre-amplifier stages, tain using two Z729/EF86 valves arked V3 and V4. Each pre-amplifier age, including the equalisation circuit signed to give correct R.I.A.A. equali- tion, is basically that used in the "Con- ol Unit with Higher Gain" of May, 60.

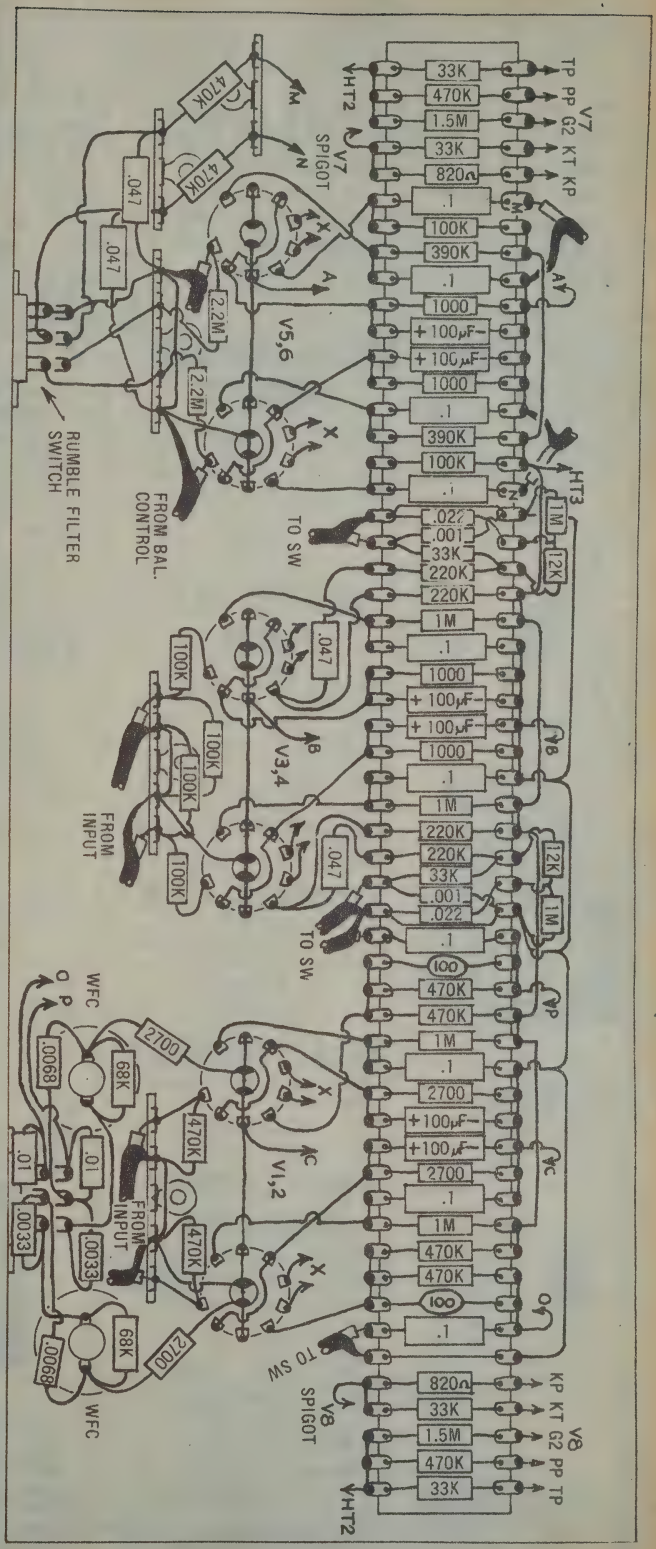
O SUIT PICKUP

A point to remember with these pre- mplifier stages is that the input resistors, belled 100K, are meant to provide a tisfactory termination for the pickup. e exact value should be used if the anufacturer states it in the data sup- ied with the pickup. If no information supplied, however, the value shown ould prove quite satisfactory for most pes.

From the pre-amplifier stages, the gnals pass to the function, mode and lance control circuitry. Here the signal be amplified by the remainder of the mplifier is selected from both the pre- mplifiers and the high-level input ckets, connected in either stereo, re- rse stereo or monophonic mode, and justed for channel volume balance.

The selection of signals from those ailable is performed by the switch arked "Function." This is a 2-pole, position rotary type, fitted with so- lled earthing plates to the rear of each ction to earth all signals not selected

(Continued on page 64)



To aid readers in reproducing the wiring of the low-level circuitry, we have prepared here a wiring diagram of this section of the circuit.

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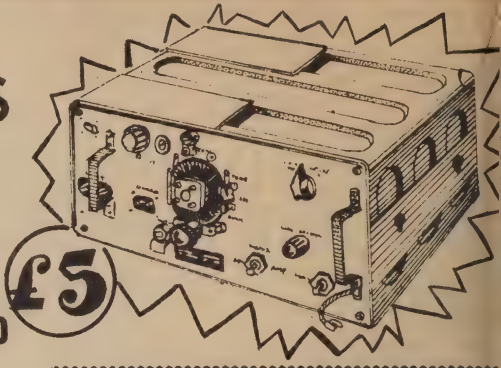

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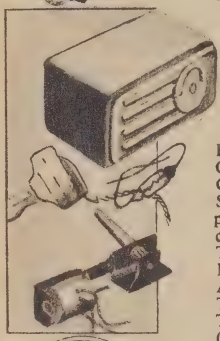

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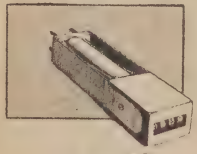

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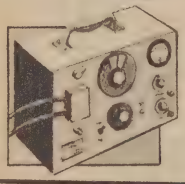

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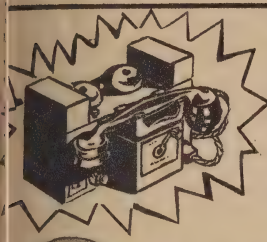

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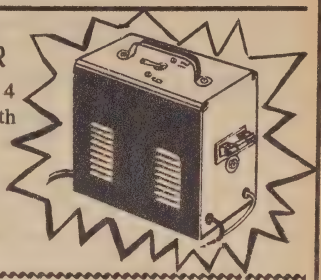

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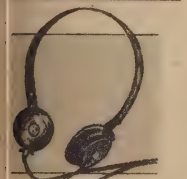

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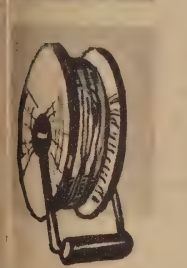

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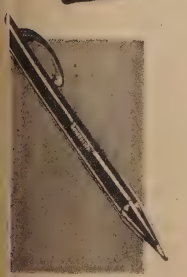

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1J6	5/-	6K7	3/11
1K5	3/9	6K8	6/9
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Condenser, variable polar pattern, pre-amplifier and power supply with windscreen. 30-15,000 CPS within 3 db. 360 degree pattern. In cardioid pattern 30-15,000 CPS. 35 db front to back ratio.

Model CM65.
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for amplification. For the benefit readers desiring to obtain the ex switch seen in the photographs, switch was supplied by Manufactur Special Products Pty. Ltd., and is ide fied by the part number AK50778.

The earthing of all unwanted sign is done to prevent stray switch capacit from coupling them into the circ actually connected, and causing ann ing "cross-talk."

The signals from the selected sou then pass to the switch marked "Mod a 3-pole, 3-position single section rot type. This merely arranges the two ch nel signals so that they either p straight through to their respective m amplifiers (Stereo), are re-directed to other main amplifier (Reverse), or joined to each other and the compo passed to both main amplifiers (Mono)

VOLTAGE AMPLIFIERS

From the Mode switch, the sign pass to the balance circuitry in the g circuits of the two voltage ampli stages. The balance control, a lin potentiometer, forms the lower resis of two voltage dividers. One volt divider is in each channel, controll the actual amount of signal reaching valve grid. As the balance control turned, the two voltage dividing rat are altered, each in the opposite dir tion to the other.

This enables the output of each ch nel to be matched with the other, correct reproduction. With two equal put signals and with equal speal systems connected to each channel, balance control will normally be turr to mid-position, with both volt dividers equal to ratio.

The top resistor of each volt divider, which is 220K, is shunted by small value capacitor. This is to p vide a small amount of high-frequer boosting to offset the effects of ca and wiring stray capacities. The f quency balance of the signal fed to tone control circuitry is thus preserv

Each signal now passes through a v age amplifier stage, utilising valves and V6 respectively. Each stage is qu conventional, using a Z729/EF86 va as a pentode amplifier. In each chan however, there is fitted a frequer selective negative feedback circuit, c trolled by a small slider switch mar "Rumble Filter."

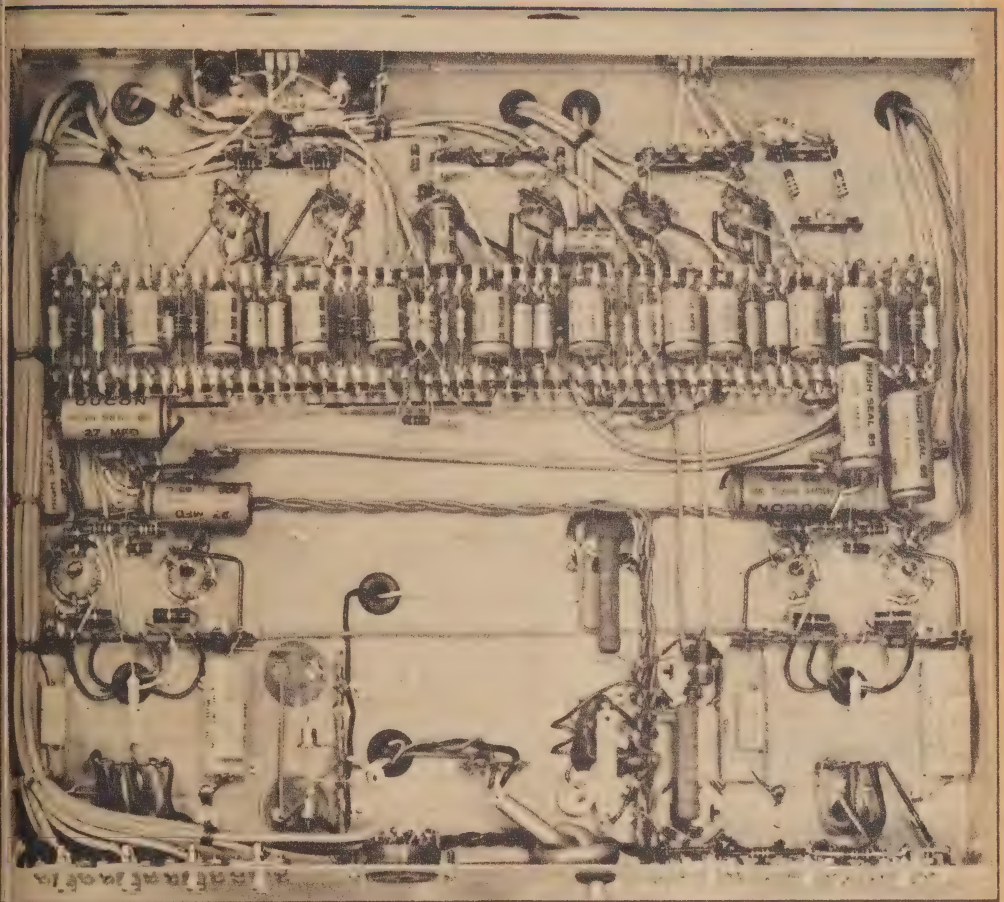
RUMBLE FILTERING

When this switch is in the "on" p tion, the negative feedback circuits connected between control grid and pl of the valves. Due to the frequer characteristics of the feedback circu negative feedback is only applied at v low frequencies. Thus the gain of stages drops quite quickly below ab 35 cycles, and is very low at rum frequencies.

When the switch is in the "off" p tion, not only is the feedback netw disconnected from the grid circuit, bu is earthed in addition. This is to ens that high-frequency negative feedb does not take place via possible st capacities.

From the voltage amplifier stages, signals pass through the tone volume control circuitry. The tre bass and volume controls of e channel are ganged to the correspond control of the other channel. Thus

UNDERNEATH VIEW OF THE NEW AMPLIFIER



Here is an underchassis view of the amplifier. The wiring for the power supply and power amplifiers is relatively non-critical, and normal audio techniques may be used. For the low-level circuitry around the terminal board, however, the wiring should be done using the diagram on page 61 as a guide.

o channel signals are treated in the ne manner, and any boosting or tting done to one is automatically ne to the other.

While there may be rare occasions en it would be desirable to treat each nal differently, the provision of arate tone controls introduces quite appreciable increase in operating mplexity. As the great majority of plications will require equal treatment both channel signals, we have thus fied dual controls, as we feel that this ults in a negligible decrease in satility.

From the tone control and volume trol circuitry, the signals are fed to grids of combined pentode-triode ves, each 7199's, used as voltage plifier-phase splitter. These valves are rked V7 and V8 in the circuit.

Basically, the 7199 valve is a selected sion of the type 6U8-A valve, but is nufactured with the pin connections ered to provide better stability in h-gain audio circuits. Thus readers who find difficulty in obtaining the 7199 valve may use the 6U8-A temporarily, but ONLY if they change the socket connections to suit. The 7199 is much to be preferred, however.

Since the 7199 combines a medium-slope triode with a sharp cut-off pentode, it is well suited as an audio voltage amplifier-phase splitter. In fact, it seems to have been designed expressly for this job, and was specified in a number of high-quality audio amplifier circuits published by the Amalgamated Wireless Valve Company, who manufacture it in Australia.

The triode sections of the 7199's are used to drive the two push-pull output valves of each channel, which are 6BQ5/EL84 valves. Two of these valves, when operated with the supply voltages shown under class AB1 conditions, are capable of supplying a power of about 11 watts to the speakers before overload and clipping occurs.

The actual output transformers used in the prototype, incidentally, were grain-orientated types. Due to the method of manufacture of the lamination steel involving grain orientation, both the permeability and the saturation flux density are increased. This means that the material may be run at higher flux densities than untreated steel, and also that it produces greater winding inductance for a given core area and number of turns.

Thus for a given frequency response (a function of winding inductance) and a desired power handling capacity (a function of saturation flux density), a transformer having a core of grain-orientated steel may have a smaller core than before and be correspondingly smaller in overall size. This allows the amplifier to be smaller than if transformers having regular steel cores were used.

The same performance may be expected from the amplifier if transformers with standard core material are used, providing the transformers have frequency characteristics and power

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ratings similar to those used. However, the increase in transformer size will mean that a chassis and case of larger size will have to be used.

Each basic power amplifier has negative feedback fitted, operating mainly from the voice-coil to the pentode valve cathode via 33K resistors. About 13 dB of feedback is used, which improves frequency response and gains stability. In addition, there is a small amount of feedback supplied from one of the output valve plates, via a 3.3 pF capacitor. This helps iron out small peaks at very high frequencies.

MIDDLE CHANNEL

To enable a third or "middle" speaker to be connected to the amplifier, the centre tap of each output transformer secondary is earthed rather than one end. This does not affect the operation of the speakers connected across each secondary, but enables the third speaker to be connected simply between one end of each secondary. (The correct combination is easily found by trial and error once the amplifier is assembled.)

The three low-power output connections are arranged to have an effective generator impedance of 10K. This enables relatively long leads to be used to other equipment without undue loss of high-frequency components. It also allows signals to be fed to transistor equipment without risk of distortion due to input impedance non-linearity present in some units. The voltages available through these output connectors are of an order suitable for "crystal pickup" inputs.

Power for the complete amplifier is obtained from a voltage-doubler supply using two 1N1763 silicon diodes (OA210 or FST1/4 diodes may also be used), with a power transformer of 190 mA capacity. The 6.3-volt supply is earthed with a 100-ohm slider potentiometer to allow hum-bucking or cancelling to be carried out.

The amplifier itself requires about 165 mA for the HT current and about 5.0 amps for heater current. This means that about 25 mA of HT current and about 1.5 amps of heater current are available for use by tuners and other auxiliary devices. A filtered HT supply of approximately 300 volts is made available at the auxiliary connector (the octal socket marked "Tuner"), together with the heater supply, for this purpose.

MECHANICAL SIDE

Now for the construction points of the design. The amplifier is built on a rectangular chassis, to which is bolted the front control panel. The complete assembly fits inside a sheet metal case fitted with perforated metal along the back to allow adequate ventilation. The case and front panel for the prototype were supplied by R. H. Oxford and Sons, who we understand will make available complete metal work kits for the amplifier in the near future.

As can be seen in the above-chassis photograph, the controls are all mounted on the front panel. The pilot light and control knobs are above the chassis, and the slider switches below it.

The six valves visible directly behind the controls at the front of the chassis are all Z729/EF86's. The two without shields at the right are the two tape pre-amps, the middle two the magnetic pickup pre-amps, and the left-hand two the voltage amplifiers.

At each rear corner of the chas we have the power amplifiers. The c put transformers are at the far r with the output valves directly front and the 7199 amplifier/ph splitters further front again. The po transformer is at the rear centre of chassis, with the two 100 mfd dou electrolytics on the right side and two 50-50 mfd filter electrolytics the left. In front of the power tra former are the filter choke and single 100 mfd electrolytic.

Along the rear of the chassis we h the input and output connectors to amplifier. At the left are the th speaker sockets, with the three cor ponding low power sockets below th Note that the speaker sockets NON-POLARISED two pin mica so ets. This allows the speakers to reversed in phase to permit quick easy speaker phasing. The sockets u were made by "Cinch," and are av able at most suppliers. (Distributed Watkin Wynne Pty. Ltd., of 21 Fal Street, Crow's Nest, N.S.W., who handle the co-axial connectors u in the amplifier.)

In the centre are the power cord the tuner or auxiliary unit connector, octal socket.

INPUTS

The input connectors are all at right hand end of the chassis rear. inputs to each channel are arranged vertical pairs, with the "Spare" the left, then "Xtal P.U.," "Mag. P.U and "Tape." The inputs to the channel are along the top, and th to the "B" channel along the botto

Looking along the rear of the fr panel from right to left, we have input selector, the mode switch, balance control, the treble control, bass control and the volume control

As the underchassis photograph sho the wiring for the power supply power amplifiers was done using c ventional point-to-point techniques. trouble should be experienced in th sections of the unit. Tagstrips are u liberally to support the wiring and co ponents, and varnished cambric sle ing used to insulate component pigt where necessary.

The components associated with pre-amplifiers and voltage amplifi however, are mainly mounted on large length of tagboard. This board quite close-spaced, and allows ma components to be mounted in a sm space. The length of board used in unit is 55 tags long, and measures 14 In actual fact, the board for prototype unit was made from a tion of perforated matrix board, terminal board of this exact size now been released. Readers may either, depending on availability.

WIRING DIAGRAM

To aid readers in duplicating the w ing of this board and the associa stages, we have prepared a wiring gram for this part of the chassis. should be used in conjunction w the circuit diagram and undercha photograph.

The main points to watch in the w ing of the complete circuit concern h prevention.

Firstly, the heater wiring should all carried out in two-pair TWIST leads. This will reduce the radiated fi Secondly, the heater wiring of power amplifiers should be taken

ctly to the power transformer connections, rather than via the heater wiring of the six front amplifier valves. While this means extra wire, it ensures that here is as little heater current in the wires near the low-level circuitry as possible.

Next comes the matter of earthing. As he wiring diagram suggests, ALL the arth wiring of the low-level circuitry ear the terminal board is insulated rom the chassis. Similarly, all the input onnectors are INSULATED from the hassis (the type used are mounted on bakelite disc, making insulation autoatic).

All the earth wiring associated with ne controls above the chassis is also nsulated from the chassis, but connects o the earth wiring on the tagboard and lso to the chassis at the power amplier input grids.

To clear up any confusion, here is ne basic idea: All the low level earth iring is insulated from the chassis until ne signal reaches the grid of each power mplifier (the grid of each 7199 penode).

EXAMPLE

With the amplifier switched to the Tape" position, for instance, the earth each input connector goes via the raid of the input lead to a lug of the lug tagstrip near the grid of the preamp. This lug goes via the two tape alve socket spigots to the floating preamp earth busbar on the tagboard.

The earth busbar is common to both ne tape and magnetic pickup pre-amp rcuitry, and thus connects to the earth raids of all four pre-amp output leads, hence it connects to the earth plates the input switch. (In our case, we sulated all but one braid at the switch nd, to ensure that there was absolutely o chance of hum loops. While this may em to be "gilding the lily," it is so sily done when wiring the unit that e did it to preclude possible trouble. nce the leads all run very close to one nother in the unit, there is little chance trouble, so readers may please themlves in this matter.)

The earth braids from the higher-level put connectors all connect to the input witch earthing plates, too. This is sential since the input connectors are l insulated from the chassis.

From the input switch, the earth conection leads to the centre tag of the lance control. Here it travels to the rth busbar of the voltage amplifiers a the braids of the two shielded leads nning to the amplifier grids. (Here ain the zealous builder may insulate one braid at the balance control end to make doubly sure of the absence of hum loops.)

From the voltage amplifier earth busbar, which is still floating above chassis, the earth connection now travels to the tone control circuitry above chassis via the earth braid of the output leads. (Here, too, one braid may be insulated at one end.)

The tone control and volume control earthing is still insulated from chassis. It then connects via the earth braids of the leads running from the volume controls to each amplifier grid. And finally, the earth connection to the chassis is made at the grid end of each of these leads. Long trip, wasn't it? But it was necessary to ensure the absence of multiple earthing and possible hum loops.

Actually, while this description may have seemed complicated, the procedure is quite straightforward. If the wiring is done step by step, there should be no difficulty in duplicating the original.

That would seem to be all the important constructional points other than those given by the circuit, photographs and wiring diagram. Before we conclude, however, a few points to observe when switching on might be in order.

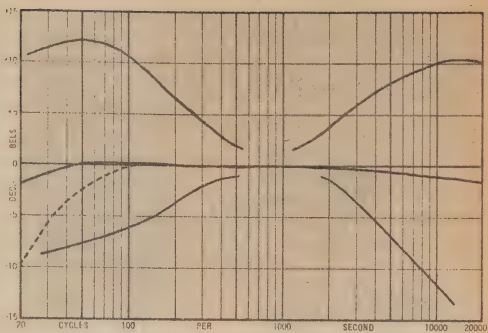
NEGATIVE FEEDBACK

The polarity of the negative feedback will depend upon the connections to the output transformer in each case, and will have to be found by trial and error. If one (or both) of the channel speakers emits a piercing scream upon switching on, switch off and change the feedback resistor to the other end of the transformer secondary of the amplifier concerned.

The second point concerns the adjustment of the hum-bucking slider resistor across the heater supply. With the amplifier switched on, turn the input selector to the magnetic pickup position and temporarily short out the two input connectors to the pre-amplifier. Then turn the bass and volume controls to maximum and adjust the potentiometer for minimum audible hum. The amplifier may now be adjusted normally and the temporary input shorting links removed.

The final hum level ("full on") should be quite low, being just audible when the ear is placed close to each speaker.

This concludes the description of the amplifier. In a future issue, it is hoped that we will be able to present a stereo tape recording unit to allow full tape recording facilities to be performed with the amplifier. Meanwhile, it should find many uses as an extremely versatile stereo amplifier.



This graph shows the effect of the bass and treble controls. Also shown in dotted lines is the effect of the rumble filter when the other controls are in the "flat" position.

TV FINDS OLD SHIPS

THE remains of wooden troopships dating from the American colonial wars are being brought up from the bottom of historic Lake George, in northern New York State, with the aid of closed circuit television equipment, manned by skin-divers.

Developed by the General Electric Company (U.S.A.) and loaned to the Regional Historical Society, the equipment has already assisted in the recovery of a complete bottom section of one ship and parts of others.

It may eventually be used to survey the entire bed of the 30-mile-long lake, which served as a natural route through the surrounding wilderness that saw bitter fighting in both the French and Indian (Seven years') War and the American Revolution.

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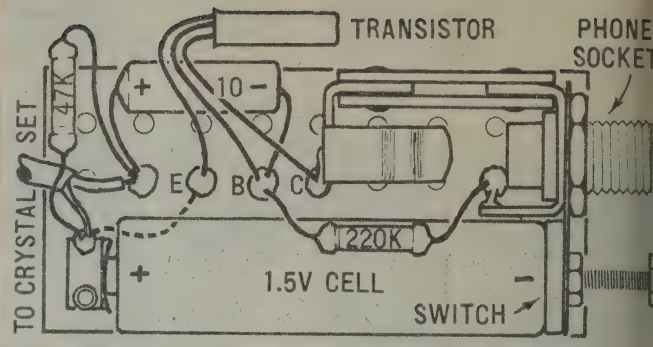
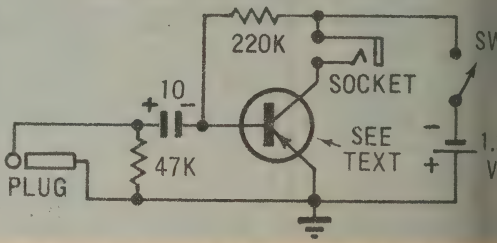




Drawn larger than actual size, the diagram above shows the wiring of the amplifier, laid out on a small piece of bakelite matrix board. The circuit diagram is shown at right.

A MIDGET AMPLIFIER FOR CRYSTAL SETS

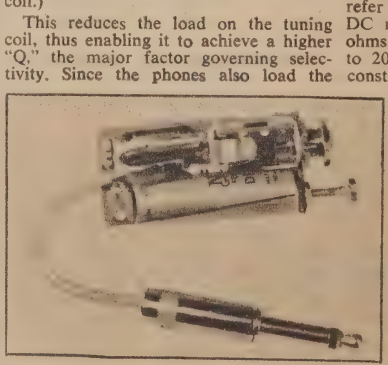
Designed mainly for our younger readers, this simple amplifier may be built as a plug-in unit to fit between the output of a crystal set and a pair of headphones. It is so simple and economical that anyone should be able to build it.

By JOHN DAVIDSON

FIRSTLY let us consider the advantages of a transistor amplifier following a crystal set. The first and most obvious is that of amplification of the poorer signals to a more reasonable listening level. The second, although not so obvious, is the improvement in selectivity which may be obtained by reducing the aerial coupling. (Tapping the aerial further toward the earthy end of the coil.)

This reduces the load on the tuning coil, thus enabling it to achieve a higher "Q," the major factor governing selectivity. Since the phones also load the coil, a further improvement should r sult by reason of the higher input in pedance of the amplifier, compared wi most headphones, particularly the lo impedance types. And if the gain allo tapping further down the coil, we w be that much better off again.

At this stage we should deviate for moment to define what is meant by hig and low impedance phones. Those v refer to as "high impedance" have DC resistance of about 2,000 to 4,0 ohms and an impedance of about 7,0 to 20,000 ohms to AC depending up construction. The so-called "low ir



These two photographs show the completed midget amplifier, exposed at the left, and pushed into a coil former (right) which provides a suitable housing.

TESTING HYBRID VALVES

n the January issue, we described the construction of an emission ype valve tester. One or two readers have raised the question of esting valves designed for use in "hybrid" auto receivers and intended to operate only with very low applied voltages.

PPLYING a standard emission test to hybrid valves raises a problem h may not be immediately apparent hose unfamiliar wth the construction his type of valve. The following dis- ion may help to clarify the situation.

order to achieve the rated gain es with the low plate voltages in- ed, these valves employ a grid wire nd very close to the cathode surface. ie application of a voltage between grid and cathode well in excess of normal bias voltage may result in rostatic attraction occurring between two elements. The normal emission voltage is in the vicinity of 30 RMS there is a strong possibility of a t short circuit occurring between the and cathode under these conditions.

s we mentioned in our earlier article ester design, such a short circuit can e appreciable damage to the tester possibly to the valve itself.

part from the grid-cathode voltage ation already discussed there is also sk that the application of test volt- of this order may cause excessive ent flow and power dissipation in the ents concerned, unless suitable pre- ions are taken to prevent this.

fter discussing the situation with the e manufacturers and carrying out a ber of tests in our own laboratory, e feel that the following method of ng is quite a valid approach to the lem.

stead of selecting the control grid, lement nearest to the cathode as the electrode, the screen is selected in- l. This assumes, of course, that the cular valve tester in question is iciently flexible to permit alternative lection. The danger of electrostatic ction is now minimised and, in nearly every type tested, sufficient sensitivity was available to permit full scale deflection for a good valve.

There were some types, however, that required the sensitivity control to be advanced to its maximum position and, even then, the reading was below full scale. In these cases we found that switching the plate in parallel with the screen gave a good deal more deflection than with the screen alone. Indeed, this may be the best approach with all types of hybrid valves, even if sufficient sensitivity can be obtained with the screen only.

A further point concerns the selection of the correct emission test position. Normally three selections are possible, depending on the type of valve under test. Hybrid valves should be tested under the same conditions as battery valves with the highest values of resistance in series with the element selected as the test electrode. (In our own tester, emission test position "1" connects a 4.7K resistor into the circuit).

The voltage drop across this series resistance will be such as to limit the voltage applied to the valve to something like 14 or 15 volts. This value is well within permissible limits and will also ensure that the dissipation rating of the valve is not exceeded.

In some cases where it may not be possible to select the screen and plate in preference to the control grid due to the design of the tester concerned, the control grid may possibly be used, providing the actual emission test is of short duration. We have tested hybrid valves in this manner, with no apparent injury to the valve concerned, but we feel that as a general rule and to be well on the safe side, the recommended procedure should be the method adopted.

MIDGET AMPLIFIER —Continued

nce" phones are the more common s available from disposal dealers ng a DC resistance of a little more 100 ohms and an impedance of -al hundred ohms to AC.

his circuit provides us with the lest amplifier possible in which the istor has a grounded emitter and collector voltage is supplied from a e pencil torch cell (1.4 volts). Bias nt is provided by the 220 K ohm rard bias resistor and the signal is ted at the base via a 10 mfd low ge type electrolytic capacitor.

marked improvement in level was ned by reducing the 220 K resistor bout 68 K when using low impedh headphones. The transistor used is FT1561 although it is likely that h suitable types may be on hand and w of these are as follows: OC70, 1, TS1, TS2, TS3, SFT152, SFT153, 6.

lysically, the most intriguing aspect his amplifier is that it is small gh to be housed in a compact unit h plugs into the headphone socket e crystal set. The headphones then plug into the new unit and are fed with amplified signals.

Construction is quite straightforward and the photographs and drawings should provide all the information required. Basis of the unit is a piece of Matrix board 2¾in x 1¾in (9 holes x 4 holes), the components being terminated on eyelets mounted in appropriate holes. Seven eyelets are used altogether.

The phone socket is anchored to the matrix strip by soldering to the eyelets mounted directly below. Battery mounting is provided by two copper contacts, one clamped by two eyelets at the positive end and the other clamped under the nut on the phone socket. A switch has been included by insulating this strip from the battery and making contact by turning a brass bolt.

We housed the unit in a plastic coil former from which the pins had been removed, and this makes an excellent little case. However, due to the flat construction of the unit it would be possible to construct a more compact case, and readers with sufficient ingenuity will doubtless wish to try this.

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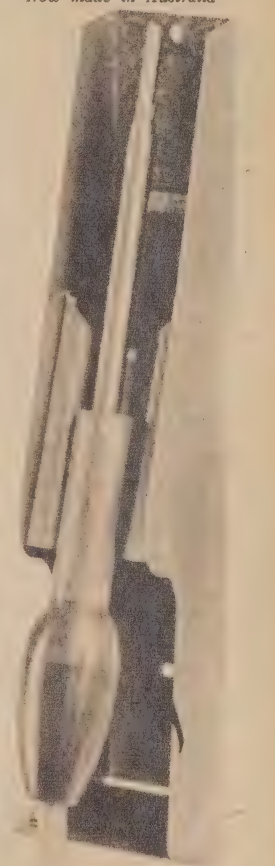

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1J6	12/6	RK48A	£3
3A4	15/	954	7/6
3B7	10/	VR105/30	15/
3D6	10/	6AC7	5/
304TH	£1/10/	EL3NG	12/6
2050	£1	2X2-879	5/
6AM6	17/6	6AJ5	9/6
1K7	5/-	VR150/30	15/
1M5	5/	6AK5	17/6
6X4	12/6	9006	5/
6J5	9/6	6AS7	12/6
6J6	15/	6A8	17/6
6J7G	7/6	CK1013	15/
6N7	10/	6SL7	15/
KTW62/6U7	7/6	EF39	12/6
1D5	7/6	EK32	15/
6F6	12/6	EBC33	12/6
EF37	12/6	809	9/6
6X5	10/	100TH	19/6
12K8	12/6	6AG5	9/6
1T4	10/	7F7	12/6
1P5	7/6	EL91	10/
6AG7	15/	EF73	10/
VT502	12/6	EF72	10/
1L4	5/	EC70	10/
6K6	7/6	V90/30	15/
AV11	3/9	IF5	7/6
6K7	5/	2A3	10/
12SJ7	12/6	807	£1/-/-
12SL7	12/6	6L6	£1/-/-
6SH7	7/6	2C26	7/6
47	12/6	RK34	7/6
843	£1/10/	1N5	7/6
957	10/6	1C7	2/6
1625	£1	1M5	5/

ROLA NEW 7x5 SPEAKERS

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12in £2/7/6

Post, N.S.W., 3/6; Interstate 6/.

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5BP1	£1/17/6
CV1957	9/6
CV112	10/
VCR138	17/6
VCR97	£1/17/6
5FP7	17/6
CV322	7/6
VCR511B	£1/7/6

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240v A.C. 50 cycle primaries. Standard 6.3 filaments.

300 x 300v 40mA	19/6
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60mA 385 x 385 vert.	£1/2/6
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250 x 250v 180mA	£3/17/6
295 x 295 300mA TV	£6/15/
115v 700mA TV	£4/17/6
750 x 750v 750mA	£7/10/
240v to 6v or 12v 1 amp	12/6

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275 x 275V 350 mA	£2/15/-
180V Double 700 mA	£2/5/-

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6V 135V 35mA	£0 19 6
6V 300V 125mA	£3 17 6
12V 325V 125mA	£3 17 6

Inverter Transformers

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12V 240V 60 Watt	£3 7 6
32V 240V 60 Watt	£3 7 6
12V 240V 100 Watt	£4 5 0
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6V, 3-pole Miniature	15/
1700 SPDT	7/6
1300 SPDT	7/6
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12 volts DPDT, 5 amp	£1
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Hi-voltage Lead-thru Insulators each: 15/ doz. 1/6
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4mfd 2.5K	£1/10/
2mfd 2K	15/
.5mfd 5K .1 8K, .1 3K AC	
.25 4K .5 2½K	15/ ea.

NEW RADIO ALTIMETERS

15 Valve Transmitter Receiver, including Wobbulator Unit.

£5-15-0

GENEMOTORS

Input	Output		
12v.	600v. 300mA	New	£5 10 0
24v.	250v. 100mA		£1 0 0
24v.	550v. 375mA		£2 0 0
24v.	250v. 60mA		£1 5 0
12v.	500v. 350mA		£8 10 0
12v.	1200v. 200mA		£6 10 0
24v.	250v. 100mA.	New	£2 0 0
12v.	235v. 50mA		£2 15 0
12v.	350v. 50mA		£2 15 0
24v.	540v. 200mA	New	£2 15 0
24v	300v. 250mA	New	£2 15 0
12v.	275v. 110mA		£3 15 0
12v.	300v. 250mA	New	£2/15/

New Vacuum Pumps

27lb pressure. 7 cu. ft per minute.

£2/17/6 Post 7/6

ALTIMETER 270deg. 1" MIL. METER.

as used in R.. TV and H. Tachometer. Post

NEW **£2-10-0** 5/-

New Coils and Intermediates

Standard or miniature to suit all valves

Coils B/C, 455 KC	9/6
Coils S/W, 455 KC	9/6
Inters	11/6
Slug tuned H.F. coils to suit 44 meg.	4/6

NEW

GENEMOTORS

12V. input, 600V. 250mA output.

£5/10/-

WANTED

Communications Receivers. Test equipment. P.A. Gear. Large or Small surplus stock. Best prices. Call, write or phone any time.

DYNAMIC HEADPHONES

Low impedance 17/6

Postage 2/6.

Dynamic microphones, type 7, 12/6 Postage 2/.

BLOWER MOTORS 24V

New American Miniature Units. Will operate as low as 6V.

£2/10/-

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Modulation Monitors

240V. AC Powered 3in C.R.O. A ready made Oscilloscope when Amplifiers added.

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For THAT C.R.O.

10 Volts, VCR97, 6in Tube with mumetal shield and socket. In Cabinet.

£7/15/-

Used units as above. These are complete with valves. But were rack mounted and do not have covers.

£3/15/-

NEW ROTARY CONVERTERS

160 watt. 50 Cycle.

24v to 32v input.

Output can be supplied for 50-110 or 240v as required.

Suit radiograms, TV, tape recorders, fluorescent lights.

£19/17/6

133. 500 watt TRANSMITTER

240 A.C. Power. 2 to 20 Mcs. Modulated Complete.

Good Order. **£55-0-0**

COMMUNICATIONS RECEIVERS

American, National, H.R.O Air Tested, Perfect Order. Coil Boxes to 30 Megs. Crystal Gate, S. Meter, 2 R.F., 2 L.F. 240V AC.

£75

AMR 101

A.W.A. Version of Abov Set. Similar Circuit an Facilities to 25 Megs.

£65

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6V Vibrator Powered 6 Band. 200K to 30 Megs. Airtested.

£25-0-0

Converted for 240v A.C. £5 Extr

MURPHY P.41

L.F. Receiver. 15KC to 700K 6 Band. Bandspread.

A.C. Powered Crystal Gate. BF THE IDEAL Oser.

£16-17-6

NEW MARCONI C10

6 Band 40 Kc to 30 megs. 10 valv 2 RF 2.IF stage. 240 A.C. Fully Band spread. Air Tested.

£65

240V A.C.

TYPE S POWER SUPPLIES

As used for AR8-AT5 Stations 575V 350mA plus 250V, 100mA Plus 12V DC 10amp.

£16/17/6

522 TRANSCEIVERS

Complete with Valves. Excellent Condition.

£8/17/6

522 Receivers. Comple

with Valves **£4/17/**

522 Transmitters. Comple

with Valves **£5/17/**

LIGHTING PLANTS

12v. 300 watt.

Direct coupled to 1 h.p. petrol engine.

Tested. Perfect order.

£36/10/-

12v. D.C. 2½ amp. As above. New. **£29/10/-**

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24V, 50AMP £5/15/

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12V 50 Amp **£5-15-0**

MEGGERS RECORD MINOR 500V

PERFECT ORDER

Post 7/6.

£15-0-0

A.C.E. RADIO

PHONE LA 3845

136 VICTORIA R'D. MARRICKVILLE, SYDNEY, N.S.W

636 KING STREET NEWTOWN—LA7008

WIDE BAND OSCILLOSCOPE

5 meg. band width. Calibrated high gain. Frequency compensated Y Amplifier 8 Position .05 to 600 volts. Push pull vertical and horizontal deflection. Hard time base. 20 cycle to 75 Kc. Latest American R.C.A. circuitry, complete with probe.

3in £49/17/6 5in £55/15/-

SINGLE UNIT STEREO-AMPLIFIER

4 WATTS PER CHANNEL.
Featuring Bass and Treble boost frequency response. 20 to 20,000 cycles.
High quality Ferguson O.P. transformers with multi match secondaries.
LATEST CIRCUITRY. SELENIUM CONTACT RECTIFIERS.

£26/17/6

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7 WATTS PER CHANNEL. Dual Push Pull, Ultra Linear Output
KIT SET £37/10/-. Wired and Tested £4/10/- extra.
Speakers to suit from £3/-/- per pair. Cabinet chassis, front panel and anodised plate only £4/5/-.

RTV&H Valve & Transistor Tester

Wired and Tested, including Valve Charts.

£37-10-0

Also Parts or Complete Kit Form if required.

TV SWEEP GENERATOR

2 Band, on Fundamentals. 5 to 6 mcgs. 28 to 40 mcgs.
Sweep Bandwidth to 12 megs.
Tuner Frequencies on Harmonics.
Prodis Sweep Unit.

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Battery Chargers

To charge 6 and 12-volt, 1 amp. **£5/15/-**
6 and 12v, 4 amp.

£6/15/-

Other Ratings To Order.

STEREOGRAM CHASSIS

Dual Wave with RF Stage.
8 VALVE, 6BA6, 6AN7, 6N8, EM80, 12AT7, 6BM8, 6BM8 5Y3.
2 Rola 8MX Speakers.

£38/15/-

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2 Rola 8MX Speakers.

£49/15/-

Send for full details on Radiogram Chassis, TV and Amplifiers.

CORDLESS STEREOGRAM

11 transistors. Tuner with R.F. Stage. 1 watt per channel.

2 7x 5 Speakers, 2-tone cabinet.

£51/15/-

VALVE, 2 x 6BA6, 6AN7, 6V6, 6BR5, 2 x EF86, 12AT7, 2 x 12AX7, 4 x EL84, 5AS4.
4 Jensen Speakers.

£66/15/-

21in PICTURE TUBES

FACTORY FRESH GUARANTEED.
90 or 110 degree.

£19/15/-

Other sizes as required.
Trade in your DUD tube £2/-/- allowed if glass not damaged.
21in Masks. 110 degree 10/-.

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Twin Track 3¾in Per Second. 2 hour play on L.P. tape. Frequency response 60 to 10,000 C.P.S. Inputs for mike. Pickup radio output. For extension speaker. Also to Hi I.M.P. Complete with Crystal mike tape spools, etc. Weight 22lbs.

£51/15/-

RADIOCORDER
Also available with built-in Tuner. Weight 25lbs.

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MINIATURE P.A. AMPLIFIER

15 Watt output extended frequency Ferguson Multimatch Voice Coil. O.P. transformer inputs for crystal mike and pickup with separate mixing gain controls. P.P. EL84 — 6BQ5 output fitted with accessory socket. Dimensions 12in x 8in x 4½in. fitted in Playmaster 2 Cabinet.

£17/15/-

240V A.C. operation. 240V A.C. and 12V D.C.

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Public Address Range
240v-AC

6 Valve, 10 watt, **£14/17/6**
6 Valve, 25 watt, **£25/17/6**
6 Valve, 40 watt, **£32/7/6**
7 Valve, 20 watt, **£22/17/6**
6-valve, 50 watt **£34/17/6**
100-watt **£63**

Battery Operation

6 valve 6v, 10 w **£18/15/**
7 valve, 12v. 12 watt, **£19/15/**
7 valve, 12v. 25 watt, **£24/17/6**

BATTERY-AC OPERATION

6 valve 6 x 240 10 watt. £20/15/-.
7 valve 12 x 240 12 watt. £21/15/-.
7 valve 12 x 240 25 watt. £29/7/6.

TV ANTENNAE

A Complete Range from

£4/15/-

TAPE DECKS

B.S.R. Monardeck
Twin Track 3¾in as used in R. TV and H. Tape Recorder a very efficient and reliable unit. With excellent performance.

£21

English 3 speed Twin Track Push Button Unit with counter position locator. Recommended for Mullard circuit.

£27/17/6

MOTEK ROBUK RK3

Latest English 3-speed Twin Track Deck. Push-button, 3 motor unit. Position Indicator. Superimposing Facilities.

£27-17-6

Chassis and Cabinets available for above Units.

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240v. AC power.
6 band. Accuracy 1 p.c.
120 Kc to 270 megs.

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AUDIO OSCILLATOR

4 Band, 20 Cycles to 200 KC Accurately calibrated for sine and square wave.

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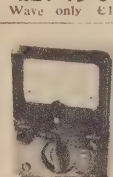
Sine Wave only £17/15 -

K 20



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MULTIMETER

20,000 O.P.V. sensitivity.
Ranges:
DC volts, 0, 10, 50, 250, 500, 1000.
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DC current 0.50uA. 0.25. 0.500mA.
Resistance, 0.50K, 0.05 meg. 0.5 meg.
D.B. minus 20 to plus 36.

£7/19/6

MODEL K.2

2000 O.P.V. Sensitivity:
Ranges as above except 50uA.

£5/12/6

Post, N.S.W., 3/6; Int., 5/6.

METERS

Flush mounting.
1½" moving coil. 1mA.

£2/5/0

0 to 50uA.

£4/15/0

STEREO PLAYER

4-speed.

£10/17/6

Stereo Changers, 4-speed,

£14/17/6

9V B.S.R. Transistor Stereo. Player.

£12/17/6

New Transporta 7

With R.F. stage. 1 Watt Audio.
Using drift type transistors. Improved range and performance.
KITSET £25/17/6
WIRED and TESTED, £28/7/6.

"The cost of a hi-fi tape recorder a television set and special tapes would certainly put the equipment beyond the reach of the average person but many people would already have a television set and a good tape recorder.

"Who knows? Perhaps one could show home movies on a television set or even black and white stills.

"What's your opinion?

Yours Faithfully,
N.B.

Imagine the "oohs" and "ahs" if N.B. should happen to read something like the following:

"Already on the continent there are vision juke boxes. Now a firm called Radiovision has begun producing vision discs for this country."

Or this:

"The advent of vision to gramophone records was demonstrated by Radiovision (Westminster) Ltd., at a reception at the Mayfair Hotel on Wednesday."

Or yet again:

"The advent of vision to gramophone records was as inevitable as the advent of sound to motion pictures. It is now an accomplished fact . . ."

I haven't made these sentences up. All of them are actual quotes from overseas material.

Let's Buy An Argument

It seems that the latest source of confusion for interested but not very technical people is the variety of references which have appeared in overseas publications to "vision discs" and such like. The references and descriptions have been elastic enough in some cases to admit the thought that revolutionary discs which will let you see as well as hear your favourite artist are just around the corner.

By Neville Williams

SOME writers and readers, with little technical background, have obviously built up a mental picture of a modified type of record player, which you might perhaps connect to your television set.

You slip a "vision disc" out of its cover, put it on the turntable much like an ordinary stereo disc, and, presto, you have sound and picture to match.

GARBLED REPORTS

Quite independently, others have been speculating about the possibility of obtaining picture with recorded sound, and one can imagine how their enthusiasm would be sharpened by garbled reports that this was, in fact, now practicable.

As an illustration of such enthusiasm, may I quote a letter from a reader in Cronulla, N.S.W.

"Dear Sir,—

"Some time ago a friend and I were playing records. One of the tracks was a song and dance routine from a film and, as I endeavoured to remind him of it, it occurred to me that just as man has recorded sounds via the gramophone record, and tape recordings, one might also record scenes by similar methods.

"The means of producing a visual image by electronic means is well established and the means of recording electrical signals is even more mature.

"It would seem to me that using a suitable disc or tape recorder and a television receiver, an image as well as sound could be reproduced by feeding the signal into the latter at a point forward of the tuning circuit.

"I understand some of the difficulties inherent in the scheme. The first would probably be the frequency range needed to build up a picture many times a second. I understand that this is beyond disc recordings but tape run at high speed may well be a practical proposition.

"The technique of recording two tracks simultaneously is well known and with tape (I think) could easily be extended to three to give both visual and stereo effects.

The writers go on to make conc sional remarks about presently involvi film or tape but reassures the rea that . . .

"There is no reason at all wh within a year or two, these dis should not be available to the publ to be played at home."

Another author says; in virtually same words:

"I can see no reason at all wh within a year or two, these dis should not be available to the publ to be played at home, possibly on television set."

Unfortunately, the facts as I kn them don't even begin to fit these o mistic predictions.

FALLS FAR SHORT

Despite the large degree of refi ment which has gone on with grar phone discs, the range of frequenc which can be recorded falls far sh of that required to reproduce mov pictures having useable definition.

t best of my knowledge, there is not en in sight any development which uld give cause for hope that we shall l able to buy sight-plus-sound gramo- one records.

As far as tape is concerned, the posi- n is not very different, at least from e domestic viewpoint. Quality for ality audio tape recorders are very ilar in their capabilities to disc uipment; they suffer much the same itations in terms of frequency res- nse.

To attain the requisite response by eding up the tape has largely been opped as a method, even in profes- nal circles.

O PRESENT PROSPECT

So I don't see any prospect, either, of taining sight and sound by a com- nation of a television receiver and ything resembling a domestic tape r order.

What then is behind these reports? Primarily, it appears to be sale pres- e behind a method (or methods) of nsferring to television the "disc key" of sound broadcasting.

Explaining the virtues of the scheme me may well query my choice of the rd) one account continues:

"Now with records that you can see d hear, your favourite disc jockey ill have scope to operate on TV just he does on radio. For a turntable screen is substituted — and Bob's ur uncle! He can cut from one disc another, appear in the middle of manipulate his program exactly as likes."

Presumably, because the central figure this picture is to be a disc jockey, n you have to be consistent and talk ut vision discs.

n point of fact, the vision part and, far as I know, the sound as well, are rded on film or on videotape and yed through normal telecine or video- e equipment. Technically, there uld appear to be not the slightest dif- ence between this and what local tele- ion stations do over and over again, recording and replaying musical items m earlier shows.

The difference, presumably, is simply e of arrangement and organisation. e some of the big-name record com- nies are mentioned, I take it that their ntract artists would likewise be in- ved.

HIT PARADES

tip that the plan is to record selected mbers both aurally and visually. Tele- on stations could run their hit parades l disc jockey sessions using both. oadcast stations would use the sound y, as now. Private record buyers uld purchase mono or stereo discs, o as now.

And that is the position which, I agine will remain for many years to e. Frankly, I just can't see videotape roducing equipment coming down ficiently in price for many a long day, become a practical proposition for the mestic market.

f we must have sound-plus-sight re- dings, conventional sound film equip- nt would look to be a good deal more ctical, with the added advantage of her definition, larger screen area and ours as well. But few show any inclin- on to sound film as a home enter- ment medium, even though huge quantities have been available for years, either cheaply or for nothing.

Is there any basis for hope that the mere availability of hit numbers in sight and sound will change this?

In more general terms, I am not impressed by any of the plans and suggestions I have heard for viewing one's own slides or films or even videotapes via the domestic television receiver.

Technically, it may be possible and perhaps interesting. Practically, it would be both costly and disappointing.

What possible incentive would there be to view slides in a black-and-white line structure, which one can already see without the lines and on a large screen in full colour? This is by using a simple, cheap, optical projector.

Or, if you want movies, you can have either 8 or 16mm. in colour and probably sound, for a good deal less, at least for the time being, than what one would expect to pay for a play-through-your-TV adaptor.

In short, I think you can quite safely polish up your record player or tape recorder for another season of use. Whatever the commercial interests may contrive for television disc jockeys, you'll be listening to the sound of your favourite artists for a long time yet—without the often dubious privilege of being able to watch them.

PROJECTION UNIT—SAFETY FIRST

Dear Sir,

As a power engineer who deals primarily in megawatts and kilovolts, but who, nevertheless, has an appreciation and practical experience of radio and electronic matters also, I wish to criticise the presentation of an article in the March issue of "Radio, TV & Hobbies" entitled "Projection Lamp Pre-heat Unit made from Oddment Parts."

Admittedly, this article does not purport to be a constructional one, but it does give sufficient detail to enable a home "handyman" with an elementary knowledge of electricity to make the gadget. However, the article fails to stress certain elementary safety precautions which must be observed when making any appliance which is to be connected to the power mains, viz:—

1. EARTHING: The article does not even mention the need to earth the metal cover. The only reference to earthing is implied in the wiring diagram. The earth conductor is not marked as such.

2. SINGLE POLE 4-POSITION SWITCH: If this switch is used to control the projector with the power outlet switch left in the "on" position, then there is a 50-50 chance that the 4-position switch will be in the neutral conductor, leaving the whole of the internal wiring of the projector and dropping resistors energised at 240 volts above earth when the 4-position switch is in the "off" position.

There is no standardisation of active and neutral connections in power outlets or in the plugs of appliance leads. A double pole switch breaking both sides of the incoming circuit would eliminate this possibility.

3. INSULATION: Insufficient mention is made of the insulation requirements. "With due respect to insulation requirements" does not necessarily mean the same thing to the radio fraternity as it does to persons accustomed to working with power equipment.

The small tracking distances deemed satisfactory in electronic equipment where fault currents are limited to milliamps are just not good enough for mains-connected equipment where the fault current is limited only by the size of the fuse on the switchboard.

Pre-breakdown leakage currents sufficient to carbonise a track across inadequate insulation can flow from the mains without even being apparent, until the power arc on breaking down blows half the innards out of the equipment.

I realise that not many people would want to build up the particular equipment described in your article, but it could happen that some well-meaning but unqualified handyman could be given the idea of building up one of these for a projector owned by a school or church with which he happens to be associated.

Without the warnings which I have enumerated above, the results could be fatal (e.g. inadequate insulation and ineffective earthing of the metal cover).

Yours Faithfully, H.H.

From a reader in Queensland comes the letter in the panel herewith, commenting on an article on page 71 of our March, 1961, issue. He maintains that insufficient stress has been laid on the safety angle of the unit in question.

Though it can remain only a matter of opinion, I feel that the article must be consdered in relation to its environment.

If it had appeared in a photographic journal, say, or even a general hobby magazine, the criticism may have been more justified, because it would have been directed to a reader group having, in large degree, a very limited appreciation of things electrical.

PARTICULAR GROUP

In actual fact, it is directed to a reader group who are very familiar with the ramifications of electrical devices, otherwise they wouldn't be buying the magazine in the first place. The question might then be asked whether we should repeat "safety first" warnings in just about every second article we publish.

The simple fact is that most receivers and amplifiers and most pieces of test equipment involve a connection to the power mains, deliberate earthing or non-earthing of the metalwork and switches to control their operation.

In the article in question, we did

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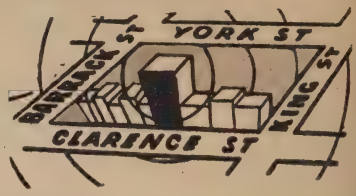

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2000 OHMS PER VOLT
POCKET MULTIMETER

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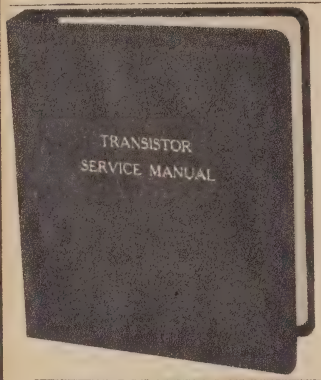


ANOTHER FIRST RELEASE!

J. R. TRANSISTOR SERVICE MANUAL
LOOSE LEAF. OVER 150 CIRCUITS
NATIONAL BRAND AND MANY
JAPANESE

£7/15/-

Reg. Post 4/6

16 further pages for the TV Service Manual now released

16/-

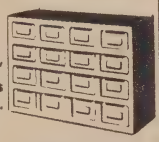
Plus Postage 1/-

HANDY CABINETS

A craftsman built unit attractively painted in pearly grey baked enamel with provision for fitting identification card on each drawer. A strong and most useful cabinet for holding small parts or tools, ideal for mechanic, engineer, garage, store-keeper or home workshop. Provision is made for stacking and all units will interstack.

Available in the following Models Packed in a Strong Carton.

MODEL A
52/-
Cabinet 12" x 9" x 5½". 16 drawers 5½" x 2⅛" x 1½".



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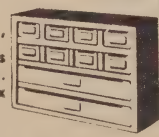

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ilicate that the metal case should be
nnected to a wire which quite clearly
jns the earthing pins of both plug and
sket. Though the point is not expressly
ntioned in the text, it should be clear
t anyone looking at the circuit; and
member that our readers are used to
oking at circuits.

In the matter of insulation, we made
ree distinct references. Regarding
sitches, we mentioned the possibility
using **"one of the new heavy-duty**
fer types" which draws a clear line
distinction against the conventional
fers, well known to radio enthusiasts.

INSULATION QUALITIES

Secondly, in nominating a substitute,
expressly based its suitability on
sulation qualities and its ability to
ry the current."

Lastly comes the phrase, referring to
embly methods, **"with due respect to**
ulation requirements."

We can only admit to the fact that
reference was made to the use of
two-pole switch and the fact that a
gle-pole type can switch the apparatus
"F" without breaking the active lead.
lfortunately, the same criticism can
levelled at many pieces of electrical
uipment—including the very projectors
ch which the unit could be used.

And even when double-pole switches
used, how often is the mains wiring
l exposed to fingers probing in the
ong place?

Undoubtedly, a double-pole switch is
good extra precaution, but I don't think
t there is any real substitute for the
roxim "pull the plug out of the wall
sket before interfering in any way with
t internal wiring."

However, while saying all these things,
r correspondent should not feel that
am discounting or ridiculing in any
y the views which he expresses.
fety should be a prime consideration
d, if we even seem to be careless on
casions, far better we be told about
lin this way than per medium of an
ituary notice.

SECOND OPINON

Discussing the same unit, a reader
m Neutral Bay, N.S.W., observes that
switch presumably opens the circuit
it passes from one resistor to the
ner, thereby partly defeating the object
the unit, particularly if the switch
rotated slowly.

First, let me assure him that the switch
the original unit did NOT suffer this
litation, having a continuous wiring
ion across a series of studs. If it had
oned between contacts, its unsuit-
lity for the purpose would have been
rly evident.

I say this with a certain amount of
erve, because it does not follow that
a momentary open-circuiting of the
tch between positions would neces-
ily invalidate the effectiveness of the
t. Having heated to incandescence
the first position, the thermal inertia
the filament would probably ensure
t the resistance remained high for the
t second involved by the break.

It's another thing we could have dis-
sed, but where does one stop? What
rted out to be the communication of
very useful idea—and it is all of that
grows of necessity into a two-page
cle, occupying space out of all pro-
rtion to its importance.

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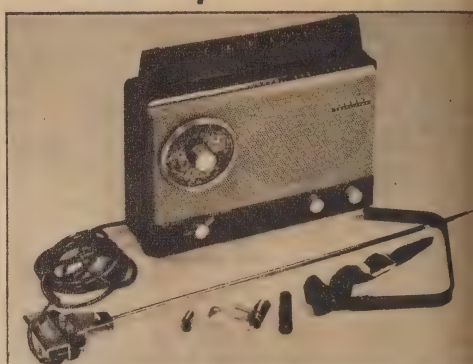
TRADE REVIEWS AND RELEASES

FERRIS 7-TRANSISTOR PORTABLE/CAR RADIO

A new and welcome addition to the range of products manufactured by Ferris Bros. is a seven transistor portable especially designed for efficient operation in a dual role as a car radio.



AS indicated by the photograph, the set comes complete with a "gutter clamp" type aerial, ignition noise suppressor kit and a seat clamp which secures the radio against sudden stops.

While the case looks like plastic it is, in fact, of lightweight all metal construction. Thus when switched for car radio use, with separate aerial and inbuilt aerial coil, the set is completely shielded and ignition problems are minimised.

A unique feature is the large, oblong section, ferrite rod aerial with its close-fitting fibreglass and polyester resin coil former. Much of the set's excellent performance is due to the close coupling between coil and ferrite former achieved by the use of this combination.

The "gutter clamp" aerial supplied with the unit can be fitted to any make of car without drilling holes or in any way marring the finish. When not in use it folds neatly into the gutter of the car, away from prying hands and "aerial benders."

One major advantage of this type of car radio is that it is virtually thief proof. When not in use it can be removed to the safety of the household.

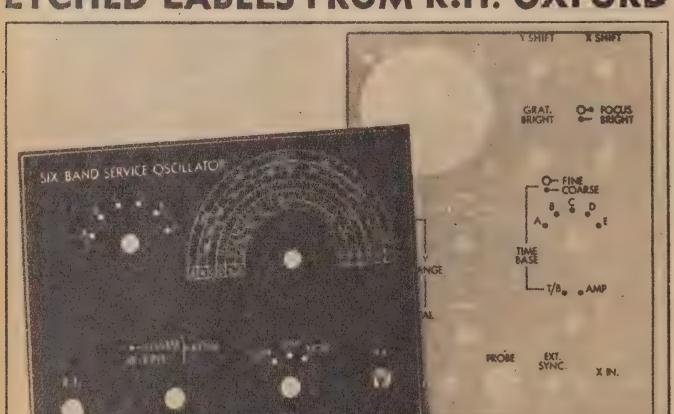
During our performance tests of the unit we found it was possible to listen to several of the country stations situated within 50 to 70 miles from Sydney while travelling in the metropolitan area.

Judging by the number of cars one sees with a miniature transistor radio hanging from the quarter window this new unit from Ferris Bros should find a ready acceptance among the motoring public who like to take their music with them when they leave the car.

The manufacturers claim that with average use of a life of 1,000 hours can be expected from the large battery used to power the unit, and in fact it has already achieved some popularity as a cordless mantel receiver. The use of a 6 by 4in loudspeaker with a special cone material results in very g tone and volume for a set of this s

Retail price of the set, complete v aerial, mounting bracket, suppress etc., is 46 guineas, and any further formation may be obtained from makers, Ferris Bros. Pty. Ltd., 752 F water Road, Brookvale, or agents in capital cities.

ETCHED LABELS FROM R.H. OXFORD



Recently released by R. H. Oxford & Son Pty. Ltd. are two new etched labels to suit Radio Television and Hobbies test instruments. The one shown on the left suits the Six Band Service Oscillator described in the September, 1960 issue. It is finished in black with nickel markings, and includes the original calibrated scale. The other is for the Three inch TV Oscilloscope of August, 1960, and is finished in nickel with distinctive colored markings for ease of identification. Further details from the makers, 97 Marriott Street, Redfern, N.S.W.

TELETRON SOCKET

ILLUSTRATED in the accompany photograph are three Teletron prod of interest to all radio/TV manuf turers and experimenters. On the ri is the well-known 9 pin socket, av able in a variety of styles, including moulding materials (black bakelite mica filled), with and without cer

shield, and with and without va shield (long or short).

At left is a new EHT octal recti socket, available in high density fla retardment polythene, with and with corona ring. It also is available in pin version.

Centre front is a four position change socket complete with short plug. It is intended mainly for s applications as line voltage adjustm on receivers and similar equipment, is available in black phenolic or m filled as required.

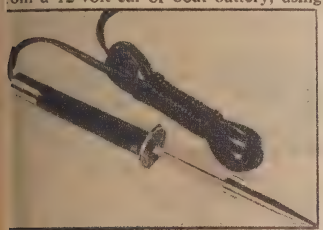
Further details, prices, etc., fr W. J. McLellan and Co. Pty. Ltd., Sussex Street, Sydney.

NEW LIGHTWEIGHT MICO IRON

THE latest addition to the Mico range of lightweight soldering irons is the 0 watt, 12 volt version pictured here. t is designed for heavy duty working /here the 10 and 20 watt versions may rove inadequate.

All the well known features of the arlier models are retained, including the lacement of the element well inside the it for maximum efficiency, chrome lated bit, and a balance which makes n iron stand unnecessary.

The iron may be powered directly :om a 12-volt car or boat battery, using



nly 3.5 amps, or from a suitable 12 olt transformer. As many workers will ppreciate, a high efficiency 40 watt on which can be used direct from a ar battery should prove a most valuable ool.

Retail price of the new iron is 65/-, omplete with cord.

For those requiring a transformer, a itable unit has been marketed under e "Pryman" brand, housed in a neat ammertone finished case, and fitted ith carrying handle, rubber feet and /o pin outlet. A three position switch lows selection of 11, 12, or 13 volts, required. Trade price is £4 plus 12½ r cent tax.

Further details of both items may be btained from Watkin Wynne Pty. Ltd., Falcon St., Crow's Nest.

E. L. HEYMANSON PHILCO AGENTS

MESSRS E. L. Heymanson and Co., 408 Collins St., Melbourne, ad- se that they have been appointed Aus- alian representatives for Philco Inter- ational Corporation, Transistor Divi- on, Lansdale, U.S.A. They plan to arket a range of transistors made by tis organisation and will be happy to ssist anyone having a special transistor oblem.

They suggest that one of the transis- rs from this firm's range will be of rticular interest to experimenters, be- g the type 2N502 designed for use in e VHF region. In a simple super- generative circuit this unit makes pos- ble a single stage receiver covering om 85 to 180 Mc.

Apart from the transistor the parts re- ired are standard items, either readily ailable or likely to be on hand, while e battery required is only 7.5 volts. oil winding data is given with the cir- cit.

The full description is given in the nsdale Application Laboratory Report o. 505, and interested readers are ad- ved to contact E. L. Heymanson and C. for further details on this or other t nsistor applications.

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B/Cast Coils Aer. Osc. RF. Known make 5/ ea.
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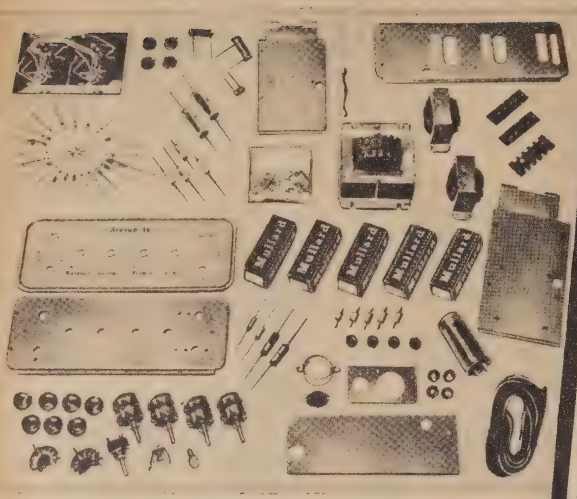

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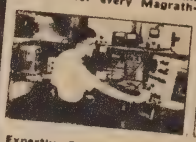

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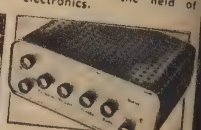

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TECHNICAL BOOK REVIEW

ES AND CIRCUITS, by G. E. hrist. Soft cover 8¼in x 5¼in, 192 ages. Gernsback Library book No. 2, with many circuits and diagrams.

his latest Gernsback paper bound on is intended both as an introduc- to general electronics and as a prac- reference book. In particular, it s with most electronics circuitry ex- ing transistor applications.

itially, the basis of non-semiconduc- electronics is explained, with conduc- leading to thermionic emission, field sion and photo-electric emission. types of vacuum tubes are explain- with extensive discussion of their acteristics.

omplete chapters are then devoted to e applications, amplifier circuits, os- tor circuits, miscellaneous applica- and multi-purpose valves. In each a most thorough treatment is given, only for the variety of applications, in the detail of each application and xplanation.

he book ends with chapters given to o-electric emission (including cath- ray and camera tubes), and indus- electronics. This last section serves lustrate the many uses of the thy- in timing and control circuits.

o sum up then, it seems a most in- ative volume for the beginner to ronics, and a handy reference for hobbyist or technician.

ur copy of the book came from tronics Publications (Australia) of adow Street, Pymble, N.S.W., who e the Australian price as 35/. (J.R.).

★ ★ ★

ITIONARY OF ELECTRONICS by arley Carter A.M.I.E.E. Hard cover, .7 pages, 7½ by 5in. Published by eorge Newnes Ltd. of London.

he spectacular and rapid develop- e of the science of electronics has ened the field to such an extent that, the new terms introduced with fic branches of the subject, both nt and scientist alike find it diffi- to keep up with these new develop- s.

the same time it has presented per- l problems to many individuals who re concerned in a secondary degree with ronic phenomena or applications. ey engineers, trained in alternative ds of technology, are finding that have to apply their knowledge to ronic equipment. It is with these s in mind that this new dictionary ectronics is presented.

hile the necessary knowledge is ilable from the many technical books dy in existence, these books often ne a prior familiarity with the al terminology, which is not always ase.

ority has been given to the inclu- of fundamental facts and terms, and her entries to a large extent follow om these. The system of cross-in- g by printing key words in small als will assist the reader to turn to entries which may provide addi- l information relating to a particular ct.

pendices provide a large amount of ated data, in most cases supplement- e information given in the body of ook.

Our copy came direct from the publishers but supplies are normally available through technical booksellers priced at 55/6. (K.W.J.).

★ ★ ★

ELECTRONIC ORGAN HANDBOOK by H. Emerson Anderson. Published by Howard W. Sams and Co., Inc., of Indianapolis 6, Indiana, U.S.A. Soft Cover, 5¼in x 8¼in, 270 pages. Copious photographs and diagrams, as well as circuitry.

This book would probably be best described as a technical encyclopaedia, as it is mainly a series of technical descriptions of the various electronic organs available in present-day America.

The description of each organ is very comprehensive. For each organ described, there is a full list of capabilities, stop combinations, and special features. A main block functional diagram is given, as well as all circuitry and diagrams of special components and assemblies. To accompany the circuitry and diagrams, there is a full technical description of its operation, written in lucid style to make ambiguity virtually impossible .

In addition, very detailed servicing instructions are given for each organ, prepared from literature supplied by the makers. Typical faults are given, such as dead notes, squealing and ciphering, with many possible causes. Full installation adjustments are given, including the tuning procedure associated with each instrument.

The organs dealt with are eight in number, being the Baldwin, Conn, Hammond, Kinsman, Lowery, Thomas, Wurlitzer 4000 (Chord) and Gulbransen Transistor. A chapter is also devoted to the "Leslie" Organ Speakers, and a final chapter to the various tuning devices available. A glossary of terms common to electronic musical instrument literature ends the book.

The book is obviously intended for technicians and people concerned with the servicing of electronic organs, but should be very useful and interesting to many hobbyists and amateurs of this growing field. Although of American origin, it is quite suitable for local conditions, as many of the organs discussed are either available here at present or likely to be in the near future.

To sum up, then, a most comprehensive book on the subject—one which has been needed for some time.

Our copy was direct from the publisher, and no data on local price or availability was supplied. However, it will undoubtedly be available in the near future. (J.R.).

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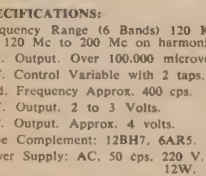

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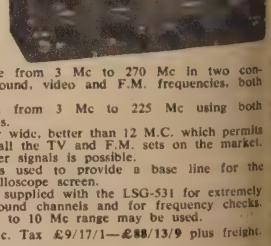

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(PERIMENTS WITH AN ECHO UNIT

)uring the month, I had the opportunity of testing in a home en- ironment, a rather elaborate unit for synthesising echoes. You may be interested in my reactions to it.

IE unit in question was the Klemt "Echolette," as illustrated below. currently being marketed in Aus- a by Messrs. Simon Gray, to whom a indebted for the opportunity of g it out in practice.

the outset, I must explain that Echolette is not primarily intended se with domestic amplifiers. Much complicated — and I presume more expensive — than the units red to recently in these columns, really intended for professional cations.

In line with this, current advertis- is directed to its possible use in dcast and recording studios, in con- ion with electronic musical instru- s or for special vocal effects in presentations, etc. Of course, if iduals are unabashed by the price by the array of controls, there is ecial reason why it should not be with private amplifier systems.

Ie Echolette uses the endless tape riple to obtain the desired effects. Ie incoming signal is split and por- of it fed to one, two, or three etic heads, which record it on an ss loop of tape. The signal is sub- ntly picked off the tape by two heads, amplified and re-combin- th the direct signal. Because of the ical displacement between the , a time delay is introduced be- the direct and the recorded sig- s

erase head cleans the tape immedi- y after passing the replay heads, for the next time around.

AGE OF ADJUSTMENT

Controls on the front allow the level e various heads to be varied, as lus the actual tape speed. This pro- e a wide range of adjustment for ent effects. In addition, it is pos- e to re-record the synthetic echo, ng from 1 to 30 echoes to be ssised, with time durations vary- om 0.1 to 3 seconds.

The Echolette has level and re- controls, multiple input chan- nd various other facilities to make re suitable for professional appli- ics. In these respects, it is a very ent proposition from "domestic" eration units which boast only input/output facilities and, at a couple of control knobs.

much for the technical side. What ce's reaction to synthetic echo as unct to home listening?

allow for maximum versatility, I ted the Echolette into one chan- a balanced stereo system, making ssible, merely by swinging knobs, en to straight mono, mono-plus- mono plus (mono plus echo), t stereo, or stereo with echo in annel.

e echo unit, by the way, was connected between the control unit and the main amplifier.)

Remembering the remarks about using the unit with electronic musical instruments, I tried the system first of all with a "straight" mono Hammond organ record.

With such a signal, it was just amazing how much echo one could pile on before the result became in any way confused acoustically. The most "impressive" effect was obtained with the signal playing through one channel straight and through the other with liberal quantities of echo; for good measure, the Echolette's inbuilt controls were set for maximum treble, minimum bass.

Under these conditions a decided difference was discernable between the content of the two channels, though one would be hard put to describe it in any terms as a stereo effect.

COULD BE USEFUL

Still, if there was need to create a difference between the channels from an original mono source, this could have been one way of doing it.

Again, having respect to the limited acoustic properties of most electronic musical instruments, one could admit the possibility of making the sound more "interesting" by the use of synthetic echo, possibly with an additional amplifier channel and frequency division for extra effect.

But any attempt to use a similar set-up on already-recorded orchestral music resulted in rather horrible acoustic confusion.

On voice, the result was nothing short of absurd. In fact, it is amazing just how little echo can be tolerated on voice before it becomes objectionable.

And this, I feel, brings me to the whole point of the matter. How does one set up an echo unit for use in a domestic amplifier system?

On Hammond organs, etc., where acceptable echo limits are far too high for anything else?

On orchestral music, where given settings may vary from inadequate to too much, according to the tempo and complexity of the sound pattern?

On voice, where the echo tolerable is likely to be imperceptible on most other material?

But why on voice at all?

BIG JOB

Admittedly, one could adjust the controls for each new program segment but what a zealot one would have to be!

In short, and based on admittedly brief experience, my reaction was that an echo unit could be very useful indeed in professional circles, where a particular effect was sought. I can still generate no enthusiasm, however, for such a device riding the programs which commonly issue from a domestic radio or amplifier system.

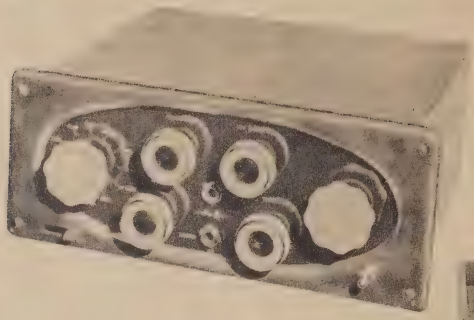
Admittedly, units giving less distinct echoes than a tape loop device may be easier to accommodate on the domestic scene but how to set them still remains a problem. If adjusted to have significant effect on material which presumably gains by extra reverberation, what of all the other material which does not?

I certainly haven't closed my mind against reverberation as a facility on domestic amplifier systems but I have yet to be convinced either of the need for it, or the practical benefits which might accrue from installing it.

It is likely that the whole matter will be put to the test locally in the near future. There has been talk of manufacturing reverberation units locally for

The Klempt "Echolette" being marketed in Australia by Simon Gray Pty. Ltd. of 28 Elizabeth St., Melbourne. Using an endless loop of tape to synthesise echoes, it is intended primarily for professional applications.

"A Complete New Range of STEREO AMPLIFIERS"



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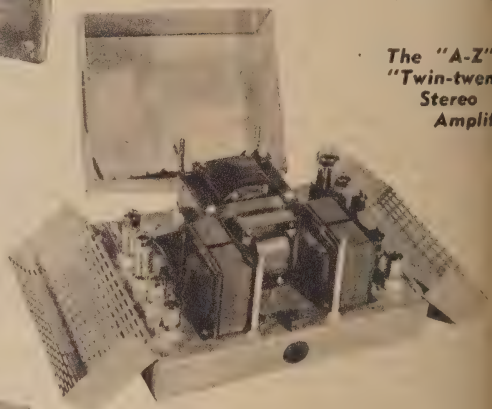
amplifiers are used by the B.B.C., leading overseas audio journals and the most discriminating music lovers. Write today for further information and prices . . . although these amplifiers are the world's best, *you will find the price rather surprising.* Encel Electronics have been appointed sole Australasian distributors. (For full technical report see March issue).



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mestic amplifiers and I have heard of least two receiver manufacturers o have stereo-radio-reverbo-grams der development.

Just in passing, there is one aspect of erberation units which may become y important to anybody desiring to one with elaborate high fidelity ipment. I refer to the method of erconnection and the possibility of ables arising therefrom.

Assuming the use of a low output gnetic pickup, a reverberation unit ld normally have to be used after preamplifier and control circuitry ahead of the main amplifier. It d hardly go later in the overall sys- otherwise it would get tangled up the main feedback network.

ut connecting a complete new device ne input of the main amplifier may y introduce hum problems, due to n loops, etc., or it may introduce ground hiss or, yet again, straight instability in the form of motor- ing.

other words it doesn't follow that can simply take a box full of cir- and cut it into an existing am- r chain. In some cases it may e no special difficulties; in others it lead to trouble with a capital "T". st but not least, there is the pos- ity of acoustic feedback between oudspeakers and the internal works echanical reverberation devices.

e shall see!

Sacred Records

AL MICKELSON PLAYS FOR OUTH. Gospel Film Ministry. GFM 3064-LP.

In this record Paul Mickelson had, s disposal, a "giant Robert-Morton organ" — a four-manual instru- with cinema-style voices and ef- similar to those of the Christies Wurlitzers.

Mickelson works them in, one by one, equally cinema-style performance, based on popular hymns and ses in lieu of popular songs. For measure, he has resorted here and to a double recording technique, hich he provides his own piano mpaniment.

with any such recital, some com- ons are more effective than others n general, the playing is workman- and replete with all the familiar le tricks.

e most notable feature, technically, recording of the big pipes, which way down, in the most impres- manner. You feel them, as much ur them. In other respects, too, the recording is excellent.

One for cinema organ enthusiasts, religiously inclined or not!

★ ★ ★

YESTERDAY'S VOICES. Narrated by Paul Harvey. Word Recording, distributed in Australia by the Gospel Film Ministry. GFM W3076-LP.

From antique cylinders and discs, dating back to the turn of the century, Word Records Inc. have resurrected the voices of many preachers and song leaders, well known in evangelistic circles.

Included on the disc are the voices of D. L. Moody; Ira Sankey, Billy Sunday, W. B. Riley, G. W. Truett, Harry Ironsides, Gypsy Smith, C. M. Alexander, Mel Trotter, Wilbur Chapman, General Booth, Homer Rodeheaver, John Brown and Peter Marshall.

The recordings, in some cases, are so primitive that the words can barely be followed. Technically, the contrast with the narration by Paul Harvey is fantastic.

Perhaps it's unfair to base any opinion on totally inadequate snippets of song and sermon but one cannot avoid the impression that the presentation of both has been likewise refined and developed over the same 60-year period.

Nevertheless, as Billy Graham points out in his cover note, these were great men of their era, with a message that remains unchanged today.

A collectors' item, the disc will be of large interest to a limited audience.

★ ★ ★

GEORGE BEVERLEY SHEA, Evening Vespers. Mono. RCA L10955.

George Beverly Shea can always be relied upon for a true and reverent performance of Gospel Songs, and this new disc is no exception.

It is one which will be particularly appreciated by the older generation, because of the predominance of traditional favourites as under: "Amazing Grace," "He Leadeth Me," "The Old Rugged Cross," "O Love That Will Not Let Me Go," "Life's Railway to Heaven," "Softly and Tenderly," "His Eye Is On The Sparrow," "Sweet Bye And Bye," "What A Friend," "Lead Kindly Light," and "When They Ring The Golden Bells."

Bev Shea is backed, on this occasion by an orchestral group, with organ and chorus for extra variety.

Recording quality is excellent, with not a trace of surface noise.

Another one for your Bev Shea collection!

NICE TRIBUTE

Dear Sir,

As a staunch reader of "R. TV & H." I must congratulate you on a very good magazine.

One portion of it receives my particular attention, namely the record reviews. I have frequently been guided in my purchases by your comments and have not so far been disappointed.

As I live in a provincial town, there are many cases where I have to order the record through a shop and I would have very little hope of returning it afterwards, should it prove unsatisfactory.

Yours Faithfully, H.S.

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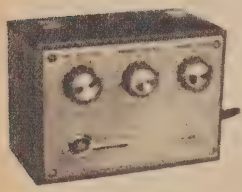

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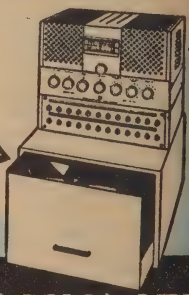

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IN McCORMACK (Tenor) Sings acred Music. Mono, Camden Col-ector's Series. CAM 62.

From a variety of old recordings, A engineers have assembled a pro-m of Sacred music featuring the ce of John McCormack. In some es the tracks are original and in-le among others, accompaniments by z Kriesler. In other tracks my tip hat a new accompaniment has been erimposed, after just about every-g but the voice has been filtered

Unfortunately, however, no amount engineering resource can eliminate distortion from the original record-

he program includes: "Holy God Praise Thy Name," "The Rosary," e Maria" (Gounod and Schubert) ount of Olives," "Panis Angelius," rist Went Up Into The Hills," "The d Is My Light," "Nearer My God Thee," "The Holy Child," "Just For ay," "Thanks Be To God."

short — an interesting collectors' but with the technical limitations must expect.

★ ★ ★

HEL WATERS, "His Eye Is On The parrow," with the Paul Mickelson rchestra and Choir. Mono, Word Gospel Film Ministry). W-3100-LP.

rom an obscure childhood in a nsylvania Negro tenement, Ethel Vers became a honky-tonk singer in slums, later to make a name for elf as a dramatic actress on Broad-, and in Hollywood. More recently has been associated with Billy ham Evangelistic Crusades.

films and on the platform she is outstanding personality. Those who w her will appreciate this record-for it is—Ethel Waters. But heard mere voice on a record, her deep imentality, her spontaneous religi-fervour and her so-called "free in-rietations" produce a result which I will have limited general ap-. This despite the commendably ar-ed accompaniments with orchestra organ under Paul Mickelson.

he recording quality itself is excel-

n Varied Mood

BYE BIRDIE, Music by Charles trouse, Lyrics by Lee Adams. Mono, orld Light Record Club, LM83.

'Bye Bye Birdie," one of later musi-l is a witty satire on teenagers and e rock-and-roll idols.

here's the idol himself, who becomes l., with the very noblest of motives; anager, too busy with public rela-; to attend to his own love life; his rated girl friend, the screaming teen-s and a bewildered parent who re-s the sentiments of all such parents his song "Kids."

bright, well presented and witty, the ic and lyrics maintain interest ghout and prompt many a chuckle. ersing the usual order, this is a case e, having heard the music, you'll to see the stage presentation.

he recording quality is superb, with ic frequency response, zero back-rnd noise and not a whisper of dis-ion.

THE STUDENT PRINCE (Sigmund Romberg) with the Sinfonia Orchestra of London, conducted by John Hollingsworth, Chorus and Singers. Mono. World Record Light Music Club, LM7008.

The Light Record Club presents yet another top quality musical comedy disc, this time the long established favourite, "The Student Prince."

Included in the cast is Marion Grimaldi as Kathie, John Wakefield as The Prince, William McCue as Lucas, Christopher Keyte as Von Asterberg—and the Linden Singers.

Diction, singing, the blend of voices and the chorus work is all good, but the orchestra under John Hollingsworth and the general balance of the whole recording is even better.

From start to finish the sound flows smoothly, with not a trace of noise or distortion.

A good one for your collection of shows.

★ ★ ★

MANTOVANI WALTZ ENCORES. Mantovani and his Orchestra. Stereo, Decca SKLA 4098.

Even the writer on the jacket can't find anything new to say about the proven and ever-popular Mantovani orchestra.

Nor can I.

This time the famous "cascading strings" bring a program of popular waltzes which are well recorded and easy on the ears. The program: "Charmaine," "Wyoming," "La Ronde," "Love, Here is My Heart, "Lovely Lady," "Moulin Rouge Theme," "Greensleeves," "Lonely Ballerina," "The Kiss In Your Eyes," "Dear Love, My Love," "I Live For You," and "Dream, Dream, Dream."

Another well recorded disc for Mantovani fans.

★ ★ ★

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The titles, which are not duplicated on any previous Wright disc in my collection, are: "Granada," "Laura," "Passion Flower," "World On a String," "Orchids In the Moonlight," "Ball Game," "Vera

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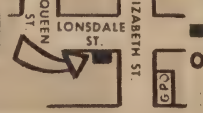

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o," "April In Paris," "Bahia," "If I e Again," "Pizzicato Polka" and ashington Post March."

The recording itself is excellent, gh I suspect that organist and engi- rs have played safe by keeping the amic range within the limits of sur- noise and signal overload. Only in ashington Post" on the inside track, the pick-up seem to protest, and then vaguely.

You'll appreciate the big pipes, if r speakers go down that far.

★ ★ ★

E PORTER SPECTACULAR. ean Campbell, Scott Peters, Lorie lann and the Michael Sammes ngers, supervised by Johnny Doug- s. Stereo, World Light Record Club, M7007.

Probably the most expressive word in title is "spectacular." From "Night Day" at the start of side 1 to "Any- g Goes" at the end of side 2, the ormers spare little time for the my and the sentimental; no sooner the mood develop, than someone s in to break it up.

I mention the point because, if you er the lively approach, you'll like this rd; if you don't, be warned!

The standard of reproduction is ine. The disc has no special vices by the same token, it has no special ines either.

★ ★ ★

TAN AND VELVET. The Massed pes and Drums of the Dagenham irl Pipers. Mono, Top Rank, TRL- 34.

Let there be no confused thinking it this record. To be sure, the players single girls, every one of them from enham, England; perhaps, too, they represented England all over the d (I quote from the cover notes) but simple fact remains that the sound Scottish as the Royal Stuart tartans the girls wear, as a uniform.

Mind you, not all the tunes they play ng from the heather. Forwarned by title of one track, "American Selec- " I could discern cadences that re- ded me of Stephen Foster. Similarly Song Tunes of Britain." But then pipes seem to do something to even best known melodies!

So there you have it: A whole twelve s of bagpipes and drums. Munch on haggis and relax, while I review thing else.

★ ★ ★

TACULAR ACCORDIONS harles Camilleri, his accordions and chestra. Mono. MGM 027562.

As distinct from the accordion band lt, Charles Camillero works here, as eatured artist, against a background ly of well organised percussion. No plexity of tune or tempo appears to t him—or them. The result is tune- l-rhythmic and precise, through a wide ty of moods.

The titles: "Jungle Fantasy," nino," "The Hot Canary," "Kiss of r," "Summertime In Venice," "Just use," "Under Paris Skies," "Maltese a," "Petite Waltz," "Bolero" (Camil- ri "La Cucuracha" and "Carina."

Technically, the recording is of a g standard, though the reference to ially devised stereo effects" on the t of a mono disc is either an error shful thinking.

DANNY WELTON. Harmonica Performance of All-Time Favourites. Stereo, Coral CST-9329T.

If Danny Welton wasn't actually born with a harmonica in his mouth, there was at least one ready to hand. He has certainly been busy with harmonicas ever since, playing in motion pictures, for motion pictures, on television and with a variety of big-name performers.

Needless to say, he plays here with the assurance expected of an experienced artist, fitting his lead into a varied pattern of orchestral backing under the direction of Henry Jerome.

Song hits like "Peg O' My Heart," "Tammy," and "To Each His Own" are featured, every one boasting "over a million copies sold." There's little danger of your not knowing them.

The surface is quiet and the recording quality clean, though I imagine that most will enjoy it better with the controls set for a little more bass and a little less treble.

★ ★ ★

PETER USTINOV—The Grand Prix of Gibraltar. Mono. Top Rank TRL 8573.

Two classes of listener will appreciate this record: (1) Peter Ustinov fans and (2) those who thrill to the smell of tortured racing oil.

Peter Ustinov, himself something of of a race car fan, sets out to describe an imaginary international Grand Prix—of all places on the Rock of Gibraltar.

An English and American commentator take turn about in describing the scene. They interview German, Italian, English and other drivers, question a Russian observer and broadcast a classic speech by a doddering Governor. Finally comes the race itself and the official arrival of the Duke of Edinburgh, all in satirical vein.

The amazing thing, which Ustinov fans will appreciate, is that the voices and allegedly the sound effects as well, come from the one set of vocal chords.

As I said before, if you're a Ustinov or a car racing fan, you'll enjoy the record. If you're not in one of these groups, you'll probably wonder half the time, what the others are laughing at.

Quality—good.

★ ★ ★

"OUR GLAD" (Volume 3) Gladys Moncrieff with Orchestra, Directed by Gil Dech. Mono, Columbia, 330-SX 7635.

What Australian in the middle-aged group doesn't have a soft spot for Gladys Moncrieff?

For this third LP album, more of her well-remembered songs have been collected, mainly from 78 rpm recordings made during the height of her popularity. The transfer to LP has been carried out in quite commendable fashion, for, while the limitations of the old discs are unmistakable if you listen for them, they do not intrude to anything like the extent that I have sometimes heard. I gather that most of them have been copied, not from pressings but from the actual metal "mother."

The titles (abbreviated):—"Spinning Wheel," "Wake Up Smiling," "Valley Of The Moon," "Always In My Arms," "Play, Fiddle Play," "If Love Is A Dream," "Sea Of Romance," "Heart's Desire," "Sing Me To Sleep," "Dry Those Tears," "Whisper And I Shall Hear," "Violets," "O Promise Me."

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2064	125	340 315	135 TAP 125	6.3 C.T. 6.3	2.25 2.25	16	4	15	3⅞	2½x2 9/16	3½x3 5/16	VLN 34
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3042	12	150	205	600	2	6	VLN 25	2 x 1¾	2⅝ x 2½	3⅛
3043	12	175	185	600	3	3	VLN 25	2 x 2¼	2⅝ x 3	3⅛
3044	12	200	165	600	4	4	VLN 31	2 5/16 x 2½	3 x 3¼	3½
3045	10	250	130	1000	5	2	VLN 34	2½ x 2½	3 5/16 x 3½	3⅜
3046	10	300	90	1000	6	11	VLN 34	2½ x 3	3 5/16 x 4	3⅜
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IN REVIEW—By JULIAN RUSSELL

RANK GLAZER—Disc To Browse Through

nk Glazer (Pianist) plays Musical Autographs. Schubert — Ecossaise for Seraphine Schellmann; Album Leaf for Anna Honig: Mozart — Marche Funebre del Signor Maestrocontrapunto (K453a); Beethoven —Fur Elise; Bagatelle in D major: Chopin — Album Leaf for Anna Szeremetieff; Nocturne in E Minor (Posth.): Liszt — Album Leaf for Gustave Dubousquet; Album Leaf in the form of a Valse; Album Leaf for Madame Kalergis; Valse Impromptu: Wagner—Arrival of the Black Swans (for Countess Pourtales); Album Leaf for Princess Metternich: Debussy — Album Leaf: Purcell — Untitled Piece: J. S. Bach — He Who Lets God's Will Be Done (Chorale): Lully — Air Tendre. Concert-Disc Stereo CS219/26.

This young American pianist plays l these trifles with both charm and uority, stroking in most of the items elicately inflected tone from his inument. Only in the Beethoven Bagae does he momentarily escape from a od of gentle romanticism to adjust i style to the composer's more forceu statement.

is a delightful disc to browse hough, choosing an item here and rther there. I do not, however, recumend playing both sides at a single ling. That way you may notice a ilarity of style throughout which ght finish by tiring you.

found its chief interest in the novl of many of the pieces, some of ich I never knew existed. The Wagnan items, for instance, glance back oTristan and forward to the Masteriers and are surprisingly well-knit, coing, as they do, from the pen of a coposer who tended to length rather hn compactness.

he two Mozart items, too, provide eshing new experiences. The Funerl March for Signor Maestrocontraotto is rather in the mocking mood fhis Musical Joke for orchestra, in ich he parodies the constructive htcomings of some of his contemporrs, and the Andante for a Cylinder fi Small Organ finished up as a cylner for a musical box. Mozart's unn akable genius emerges here despite ni intended triviality.

here is, in fact not a dull piece in h whole recital, and the piano tone as with the best I have ever heard ecorded. I must, however, still be peruaded that two-channel reproduction is necessary for the single instrument used he. After all, the sound originates rm only one point, and I can't see h anything is gained by spreading it, hugh admittedly, on this disc, it remns beautifully stable between the w speakers.

★ ★ ★

Rthmaninoff — Variations for Piano on a Theme of Corelli, Op. 42. Preludes in C Sharp Minor; D Major; G Minor; E Flat Major; G Major and G Sharp Minor. Richard Farrell. Pye Mono PLC5023.

The Variations are not examples of Rachmaninoff at his most inventive despite the introduction of a few lovely bars here and there. Although its opus number suggests late composition, it uses little that might not have occurred to any resourceful student of composition. The variations' chief merit, for pianists, will probably be provided by their unfamiliarity, and I cannot imagine them interesting many other listeners. But every bar bears the unmistakable imprint of the composer, despite its frequent mediocrity.

By a strange inaccuracy Rachmaninoff attributes the theme, "La Folia," to Corelli, the 18th century violinist who used this traditional dance tune for a more famous set of variations. It was also used by Bach and a hatful of other composers of the period.

Farrell's playing is studious but unexciting, at its best in the lighter numbers but verging on the reticent in the more extravagantly romantic. The reverse side, with its group of Preludes, should provide wider appeal. In these Farrell exhibits the same stylistic characteristics that appear in the variations.

His technical proficiency is never in doubt, though his emotional conviction may be a little suspect. Apart from slight dryness, the piano tone is commendably faithful. The dryness, surprisingly, manifests itself at the extremes of the instrument in the Variations but in the middle register during the Preludes.

★ ★ ★

Tchaikowsky — Symphony No. 6 in B Minor, Op. 74 (Pathetique). Boston Symphony Orchestra conducted by Pierre Monteux. R.C.A. Mono L16263.

Pierre Monteux' recordings have till now given me so much pleasure that I feel sharp regret at having to register disappointment with this disc. Here Monteux is far from his best, which can, of course, be as good as anybody's recording today.

There are moments of quite ravishing beauty, but generally speaking his tempos tend to exaggerated changes, though he never misses the opportunity to introduce a really thrilling climax whenever it presents itself — which, in the symphony, is very often indeed.

Some of the frenzied passages in the first movement go very fast indeed, though they never tumble over themselves. And in the second, Monteux' jog-trot rhythm in that most flexible of time signatures, 5/4, destroys all sense of Tchaikowsky's "grazioso" marking. The scherzo is as lively as anyone could desire, with some overbalancing of the woodwind that might not be so prominent on a two-channel version.

The string tone is quite lovely in the Finale, with the enchanting pianissimos that hold the interest despite the conductor's tendency to drag the tempo.

And the whole ends on a convincing note of utter desolation.

The mono sound is a trifle cramped but shows evidence of more spacious treatment in a stereo version, should one ever appear. Yet despite its many merits, I still feel that this is by no means vintage Monteux.

★ ★ ★

Schubert — Symphony No. 8 in B Minor (The Unfinished). Rosamunde Overture; Entracte No. 3 in B Flat Major; and Ballet No. 2 in G Major. Royal Philharmonic Orchestra conducted by Paul Kletzki. World Record Club Stereo TE237.

Kletzki's reading emphasises the large symphonic structure of the symphony rather than its more melting aspects. This he does by giving the dramatic interludes their full measure of passion, using an unusually wide dynamic range to achieve his end. You will find his interpretation far removed from the romantic musings so often stressed by other conductors.

The engineering is outstandingly good, rich, spacious, and clear, with a glowing string tone, sensitively played woodwind, and magisterial brass. At its club price it represents excellent value.

The Rosamunde items are not quite so successful. The playing here, especially in the strings, suggests that less time was perhaps spent on rehearsal than on the symphony, though, here again, the woodwind can be listened to with continuing delight.

The surface on Side I is clean, that on the reverse a trifle prickly.

Music of India. Ravi Shankar (Sitar) with Chartur Lal (Tabla) and N. C. Mullick (Tamboura). Ragas and other traditional Indian Music. Record Society Mono 20/6020.

This must be of outstanding interest to students of Asian music, though it might win further popularity among the merely curious. The sleeve notes state "In Ravi Shankar, the music of India

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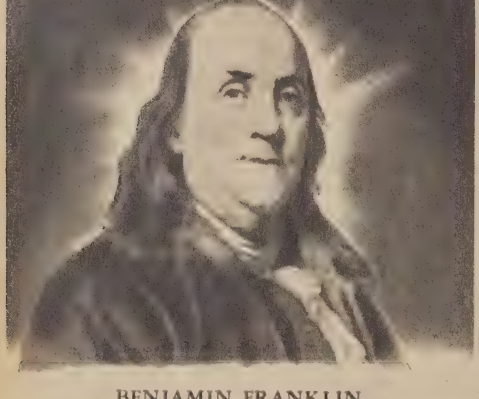

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Knowing as little as I do about such
ings, I am content to accept this en-
siastic introduction as vouching for
authenticity of everything on the un-
al disc. I found it all vastly interest-
—and instructive—but tending to be-
ne a little monotonous to my West-
ear if taken in too large doses.

Most of the sound is produced by a
ir, a plectrum-plucked string instru-
nt with a curiously nasal tone, the
ch altered by sliding frets that add
sandos—and what sound like quart-
ones—to the usual scale. The treble
ves freely over a ground bass. In
ne of the items a percussion accom-
niment is added.

The disc is contained in a very hand-
ne folding sleeve which also carries
ormative notes about the music and
former.

★ ★ ★

Glazounov — The Seasons, Ballet. L'Orchestra de la Societe des Concerts du Conservatoire de Paris conducted by Albert Wolff. Decca Stereo SXL2141. Mono LXT 5240.

The mono version of this light, es-
tially pleasing music appeared in
England towards the end of 1956, when
was acclaimed as an impressive ex-
ple of the Decca engineering of the
iod. Even today it can hold its own
h much more recent examples of
mono recording science.

To this, stereo has not surprisingly
led space and depth which points the
sitive playing of the French orches-

The music, though unmistakably
ssian in flavour, belongs to the Tchai-
wsky-Rachmaninoff school rather
n that of the Russian nationalists —
Katchka. It is consistently tuneful,
retentious, and put together with
erlative skill, and the simple titles of
movements remove any need for de-
ed explanation of what is going on
the ballet.

For balletomanes it might be poin'ed
that it was the last of the Petipa
lets, produced in what was then St.
ersburg in 1900 with Pavlova in the
e of the Frost Fairy. It may also
erest them to know that contempor-
English choreographer Ashton has
d some of the music much more re-
tly in his ballet, "Birthday Offering."

t will, of course, appeal most to
ers of music of the lighter type,
ugh even the most sophisticated
eners will find much to admire in its
ful workmanship and the graceful
formance it receives here.

★ ★ ★

Strauss (Johann)—Die Fledermaus Gala Performance. Complete Operetta with dialogue and Guest Artists. Hilde Gueden (Rosalind) Waldemar Kmentt (von Eisenstein); Erika Koth (Adele); Walter Berry (Falke); Eberhard Wachter (Frank); Giuseppe Zampieri (Alfred); Regina Resnik (Orlovsky). The Vienna Philharmonic Orchestra and State Opera Chorus conducted by Herbert von Karajan. Guest Artists: Renata Tebaldi, Fernando Corena, Birgit Nilsson, Mario del Monaco, Teresa Berganza, Joan Sutherland, Jussi Bjorling, Leontyne Price, Giulietta Simionato, Ettore Bastianini and Ljuba Welitsch. Decca Stereo. SET 201/3. Mono MET 201/3.

I had better start by describing the significance of the words "Gala Performance" in the title of this luxuriously produced set. It seems that at the New York Metropolitan, Die Fledermaus is given regularly on New Year's Eve. Artists not engaged in the production but resident in New York at the time contribute solo items during the Ball Room Scene in the second act.

So it is that we have Renata Tebaldi singing "Vilia" from "The Merry Widow," Corena in a French ditty, "Domino," Birgit Nilsson in "I could Have Danced All Night" from "My Fair Lady," de Monaco yelling his way through an Italian ballad called "Passione," Teresa Berganza, accompanied by her husband, Felix Lavilla, in an arrangement by him of an exquisite Basque "Lullaby," Joan Sutherland in "Il Bacio," Jussi Bjorling in "You Are My Heart's Delight," Leontyne Price in "Summertime" from "Porgy and Bess," Giulietta Simionata and Ettore Bastianini in "Everything You Can Do I Can Do Better" from "Annie Get Your Gun" —this one preceded by a subtle quotation from Verdi's "Falstaff,"—and Ljuba Welitsch in "Wein, wein nur du allein."

As you have probably noticed these items are not typical of the performers who give them here. They are introduced in a spirit of fun and must be accepted, I think, in the same spirit. No one but a captious bore would seek faults in these friendly offerings. And if you are among those who resent interpolations into an acknowledged masterpiece, you can easily skip them and stick to Johann Strauss on his own without even a twinge of conscience about the precedent set by Rossini in "The Barber of Seville."

As to the performance of the operetta itself, none, I think, will be disappointed though many might have reservations about Karajan's rather too forceful drive which results in much spirited playing from the Vienna Philharmonic.

Some, too, may miss Schwarzkopf in Hilda Gueden's role of Rosalinde and Rita Streich in Erika Koth's Adele.

But these are only quibbles and one would need to be a churl indeed to refuse grateful acknowledgement of a work so beautifully presented in both the mono and stereo versions. Each is fine, with the stereo well ahead of a set that even in mono is outstanding in every aspect of the recording engineer's skill.

★ ★ ★

Mozart — The Magic Flute. Complete Opera. Hilde Gueden (Pamina); Wilma Lipp (Queen of the Night); Emmy Loose (Papagena); Leopold Simoneau (Tamino); Kurt Boehme (Sarastro); Walter Berry (Papageno); Paul Schoeffler (The Speaker); August Jaresch (Monostatos). The Vienna State Opera Chorus and the Vienna Philharmonic Orchestra conducted by Karl Bohm. Decca Stereo SXL2215/6/7.

The original mono version of this opera, put out some years ago, was distinguished for its excellent balance and all-round engineering. A comparison with the new stereo issue reveals some better definition of orchestral details, an opening-up of the ensembles, and the

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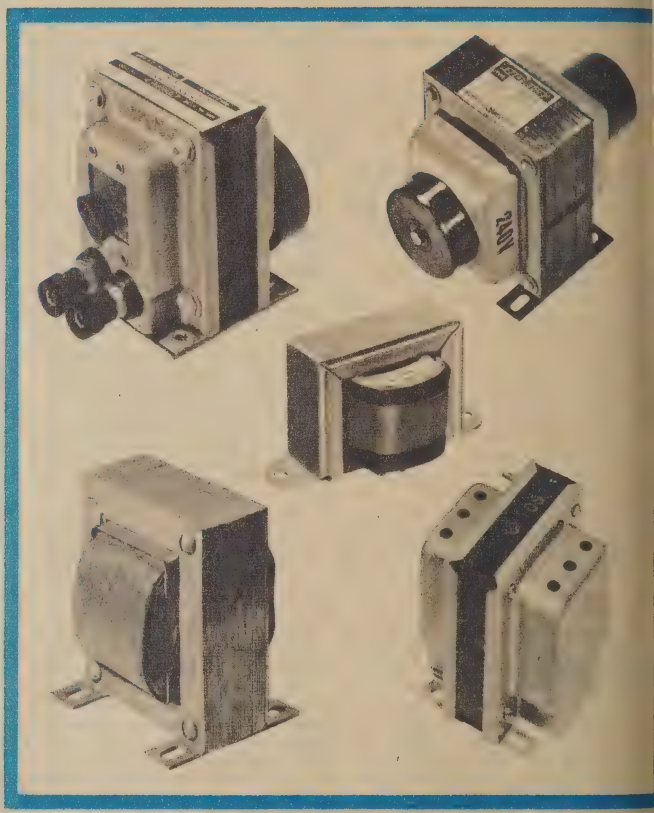

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roved placing of the solo voices in ion to the accompaniment. Mono- is' aria still seems a thought too e to the mike. It never suggests com- from a distance as Mozart intend-

ut Wilma Lipp recedes gracefully much better perspective, and Hilda den's voice acquires still more tonal ity than it had in the original — that was a delight to listen to. To knowledge, this is the first Magic e to become available in stereo. It always my favourite in mono, and ains so in its new guise, though a er would not be difficult to imagine. "dialogue," by the way, has been ted with no great loss, to my way of king.

★ ★ ★

alleavallo — Pagliacci. Complete Opera. Mario de Monaco (Canio); Cornell Macneil (Tonio); Gabriella Tucci (Nedda); Renato Capecchi (Silvio); Piero de Palma (Peppe). Orchestra and Chorus of the Accademia di Santa Cecilia, Rome, conducted by Francesco Molinari-Pradelli.

Song Recital by Mario del Monaco, with orchestra conducted by Ernesto Nicolli. Decca Stereo SXL2185/6.

his is much more up-to-date stereo that in the Magic Flute, mentioned re. It has a great deal of the pre- e of an actual performance with acters moving across your wall with- however, necessitating the listener ing his head from speaker to speaker a spectator at a tennis match. The t is closer akin to watching a tennis h on TV.

he balance throughout — and that ides the internal balance of the or- tra as well as that of the orchestra n singers — is impeccable except at point, the opening chorus of Act 2 re the band disappears temporarily nd the singers. The conductor's ailing of the whole score is splendidly oritative without imposing a crushing len of discipline on the soloists.

el Monaco starts a little tentatively, soon gets going in a performance of elemental rage and grief. Cornel ineil's Tonio, always menacingly illous, provides him with an effec- foil. And Macneil brings off splen- dramatic effects without loss of tonal ity.

abriella Tucci, who may be remem- d as one of the prima donnas in the Italian opera company to tour Aus- a, also starts off a little unpromis- in the Balatella, delivering it at an spired jog-trot gait, but she, too, es down later, and by the time she hes her love duet with Silvio, is ing very attractively. Capacchi de- s Silvio's tuneful music with pleas- ardour.

can find nothing to recommend in io del Monaco's recital of Italian ds that fills the fourth side.

oth Pagliacci, and the Magic Flute put out in a new type of album, side of which has a plastic window ough which the cover of the libretto es an attractive decoration. It takes ery little space on a library shelf and only one drawback that I can see— absence of information on the o.

★ ★ ★

rms—Piano Concerto No. 2 in B Flat Major, Op. 83. Artur Rubinstein and the RCA Victor Symphony Orchestra conducted by Josef Krips. RCA Stereo SL16262, Mono L16262.

This is my favourite recording of the concerto to date, as was for many years, Rubinstein's old 78 version. But it may not be yours, for Rubinstein's is no heavy Germanic reading. His graceful interpretation adds unusual elasticity to the solo part and his love of the music is continually manifested by inflections always warmly expressive but never exaggerated to the point of distortion of the composer's intentions.

But this must not be taken to imply that his playing is without vitality or that the stature of the work is reduced in any way. For Rubinstein adds all the drama that is necessary to give point to his lyrical performance and succeeds in making the Finale sparkle like a chandelier. He is given support of inestimable value by Krips in as close a collaboration as any soloist could desire.

The mono offers extremely good balance and richly varied sound for that medium, but it is in the stereo that full enjoyment of this superb achievement can be best appreciated.

RECOMMENDED

Prokofieff — Peter and the Wolf. Haydn Toy Symphony. Philharmonia Orchestra conducted by Herbert von Karajan, Narrator: Peter Ustinov. Columbia Stereo SAX02331.

Beethoven — Symphony No. 2 in D Major. Coriolan and Prometheus Overtures. Philharmonia Orchestra conducted by Otto Klemperer. Columbia Stereo SAX02331.

Walton—Belshazzar's Feast. Philharmonic Promenade Orchestra and London Philharmonic Choir conducted by Sir Adrian Boult. With Dennis Noble, baritone. Pye Acclaimed Series Mono PLC5028.

Puccini—Highlights from Turandot. Inge Borkh, Renata Tebaldi, Mario del Monaco with Chorus and Orchestra of the Accademia di Santa Cecilia, Rome, conducted by Alberto Erede. Decca Stereo SXLA-2175.

Heifetz — 18 pieces by various composers played by Jascha Heifetz with Brooks Smith at the piano. RCA Mono L16271.

Von Suppe—Overtures. Light Cavalry; Fatinitza; Poet and Peasant; Boccaccio; Morning, Noon and Night in Vienna; and Beautiful Galatea. Philharmonic Promenade Orchestra, conducted by Sir Adrian Boult. Pye-Nixa Mono PLC5026.

Beethoven — String Quartets, Vol. 4. No. 7 in F Major (First Rasoumovsky). Hungarian String Quartet. Record Society Mono 21/6021.

Mozart — Four Flute Quartets. Fine Arts Quartet with Samuel Baron (flute). Concert-Disc Mono CM-8102.

Beethoven—Piano Concerto No. 5, in E Flat (Emperor). Wilhelm Backhaus and the Vienna Philharmonic Orchestra conducted by Hans Schmidt-Isserstedt. Decca Stereo SXL2179.

Handel—Royal Fireworks Suite; Water Music Suite. Philadelphia Orchestra

(Continued on page 111)

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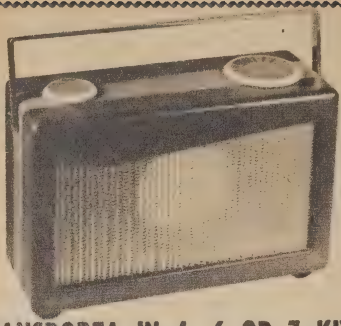

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SATELLITE BOUNCE EXPERIMENTS

Radio amateurs in various parts of the world have endeavoured to bounce their signals back from the U.S. Balloon Satellite Echo 1 since it was fired last year. Reports and recordings of these experiments have been collected for investigation.

Radio Amateur Journals in both the U.K. and the U.S. have carried much information on the possibilities of the reflection of Amateur signals from the 100 ft dia. Echo balloon. It was considered by many Amateurs that the bouncing back of signals from the satellite with available transmitting powers and in the practical antenna limits was something of a lost cause. After the launching in August last of Echo 1 Amateurs tried all bands from 7 Mc/s to 1296 Mc/s for a signal bounce despite the misgivings.

At first there was a host of reports of possible reflections using the 50 Mc/s band, but as the firing coincided with the Perseed Meteor showers most of these observations were considered due to meteor trail reflections. Other bands did not produce any positive results.

U.S. EXPERIMENTS

Perhaps the most interesting of the experiments were those conducted by W2ZBQ and K4KYL, although these stations were separated by only a few miles. These operators are able by selecting certain beam headings to make their 50 Mc/s signals inaudible at the other station. This is made possible by a high ridge between them and the deep nulls of their 9 element Yagi arrays. In the past they had heard each another via F2 scatter and other propagation modes and considered themselves in an ideal location for the testing of reflections of amateur signals from Echo 1.

Within a few weeks of the launching they had heard "Doppler" shifted signals both above (satellite coming towards the receiver) and below (going away) the direct path signal. Reception of these effects was repeated on a number of occasions and recordings were taken of phenomena. These tapes are now at A.R.R.L. H.Q. where they are being analysed.

Two interesting articles appear in the January issue of the R.S.G.B.'s Bulletin. They both cover the mathematical possibilities of reflections from the balloon satellites. One is written by O. J. Russell, G3HJ, the second by G.M.C. Stone, G2ZL. Comparisons are made between the better possibilities of reflections from the aluminised balloon compared with the Moon. Both writers consider that no rupture of established communication engineering theories is involved in expecting reflections from the balloons with some of the existing amateur equipment available for experiment.

THIRD PARTY TRAFFIC

MOST amateurs are conversant with the fact that the handling of a message for a third party via Amateur Radio is permitted in the U.S. and even encouraged.

Throughout the years many individual amateurs have considered that a similar scheme could be operated in most countries as a valuable training field for amateur operators, so inclined, and as a service to the public.

LOSS OF REVENUE

The objection raised, of course, centres around the fact, that in most countries outside the U.S., communication services, telegraph and telephone, are conducted by governmental utilities and that a loss of revenue would occur if messages were handled free by amateurs.

Considerable comment has been expressed in overseas journals on this message handling facility and proponents for the scheme point out in fact there would be little loss of revenue, if any. They say the net outcome would probably be more mail, certainly more telephone calls and perhaps a few less telegrams.

As the scheme operates in the U.S., and would have to be conducted anywhere, amateurs have no delivery service so messages are either telephoned to the addressee or a copy of the message is mailed on the appropriate ARRL message form. Messages, of course cannot be sent for commercial organisations or for monetary gain.

To offset any slight loss in governmental revenue there would be a reservoir of amateurs effectively trained in message handling and of value to the services in any emergency and to the public generally.

MESSAGE ENTHUSIASTS

In the U.S. there is a hard core of amateur personnel dedicated to their work of message handling. They spend their time in this way and judging from some of the tallies listed in the ARRL "Brass Pounders' League" traffic totals they must devote scores of hours a week to this work.

In a typical month's operation W3 CUL, for instance, handled a total of 6,399 messages, 572 originated, 2,102 relayed, 2,931 received, 794 delivered, all this work being performed on a voluntary basis for no financial return. Next station in the list W6WPF handled 2,384 messages. Both the above calls are for single operator stations.

Most of the handling of messages is performed by working into the many traffic nets that have been established through the continent. They have such distinguishing names as Mike Farad, E. and T., Dixie, Early Birds, etc., and operate on set frequencies and fixed schedules. Some of these nets handle over 1,000 messages a month.

Whether traffic handling is an asset to the Amateur Service or not is a matter of personal opinion. Judging from the published letters, quite a number of amateurs would consider the establishment of this facility a valuable phase of amateur working.

W.I.A. NEWS

THE Annual Meeting of the N.S.W. Division of the W.I.A. was held at Science House, Sydney in March. The retiring State President, Bill Lewis, VK2YB, presented a comprehensive report on the year's activity and this was followed by the auditor, Jim Cuming, VK2PM's, review of the financial position. The returning officer, Dave Duff, VK2EO, then announced the result of the ballot for the election of 7 council members for 1961-62.

An indication of the interest in the election was provided by the return of a record number of ballot papers from full members, over 400 being received. The following were declared elected:—Norm Beard, VK2ALJ, Harold Burtoft, VK2AAH, Frank Hine, VK2QL, Bill Lewis, VK2YB, Tim Mills, VK2ZTM, Vol Molesworth VK2VO and Max Pleffer, VK2MP. All the above amateurs are well known in the State and have served previously in various offices of the Division.

The President's report showed that the membership figure stood at 1,200, a net gain for the year of 68 after resignations, etc.

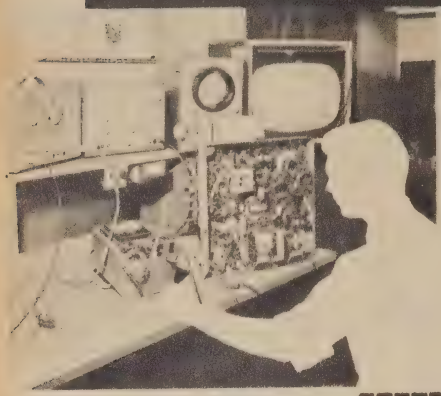
The normal monthly general meeting was held on the same evening and Peter Griffin of D.C.A. lectured on Supervisory and Remote Control Equipment. Mr Griffin has lectured on a number of occasions to the Division and as usual his discourse was of considerable interest to amateurs. He clearly showed that it was an advantage to ban the equipment to the shack up the yard and operate from the living room with the gear out of sight.

During March and April most of the N.S.W. branches and sections of the W.I.A. hold their annual election of officers. The results of the Blue Mountains section's election were as follows: chairman Jack Greenhalgh, VK2ADF, vice-chairman Bob Lear, VK2ASZ, secretary Bill Moore, VK2HZ, treasurer Norm Durham, VK2QA, publicity officers Ron Daniels, VK2ADA, Mrs Stahl and Dave Melbourne, VK2NK, construction officer Wal Cromie, VK2MZ, delegate to Divisional Council Keith King, VK2ABK.

Laurie Cartwright, VK2ZJC made a round trip of 100 miles to be present at the meeting.

The proposed extensions to the N.S.W. W.I.A. Administration Headquarters have advanced a stage further. The architect has produced final plans and tenders have been called for a two-floor building at the rear of the present offices to provide a storage area for disposals equipment and meeting-room facilities.

Put yourself in the picture



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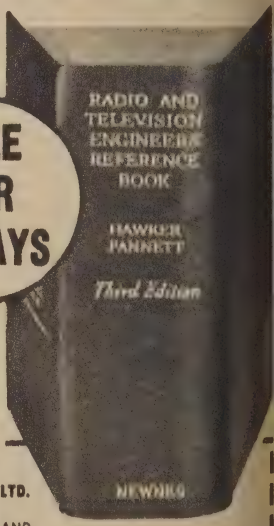

IN THIS NEW EDITION many recent developments have been covered for the first time, and numerous sections completely revised or recast to take the latest techniques into account. For example, the rapid progress and increasing application of semi-conductor devices are reflected in TRANSISTORS, providing basic information on the latest types. Modern semi-conductor applications are discussed in such articles as TRANSISTOR D.C. CONVERTERS, GERMANIUM AND SILICON POWER RECTIFIERS, TRANSISTORIZED BROADCASTING RECEIVERS, SERVICING TRANSISTORIZED EQUIPMENT, ZENER DIODES, etc. The practical use of transistors in modern transmitters is dealt with in the enlarged COMMUNICATIONS TRANSMITTERS section which also includes new material on low power single sideband transmitters, choice of quartz crystals, v.h.f. scatter and meteor burst communication systems.

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144 Mc RECORDS

THE European 144 Mc Distance records were shattered at the end of last year by means of meteor-scatter propagation. HB9RG and OH1NL contacted by this mode over some 1,120 miles. OH1NL followed with a contact with G3HBW, 1,080 miles.

The Europeans have been making good contacts using this propagation mode with powers as low as 200 watts. In spite the extreme patience required to effect a contact, they have been very active and have received satisfaction from establishing the new records.

Quite a number of "bursts" of signals have been of 30-second duration. One "burst" received by G3HBW from OH1KAW lasted for three minutes with signals swinging between S3 and S8. Early in the year during the Quadrantids Meteor Shower, G3HBW worked HB9RG for his twentieth country on 144 Mc—a fair tally for any band. Many of the leading VHF men in that continent have been concentrating on meteor scatter work, observing strict schedules in endeavours to cover greater distances.

SUNSPOT CYLES

WITH conditions improving on the lower frequency bands, it is of interest to review the progress of our present sunspot cycle (No. 19). It has easily produced the most intense solar activity since records have been kept. The predicted sunspot number issued by the Zurich Solar Observatory for the first month in 1961 was 101. Although these numbers do not provide an indication of day-to-day conditions, they certainly do indicate the general trend of the average propagation to be expected. It is generally accepted that the current cycle began in April, 1954, with a sunspot number of 3 and this had risen to 23 in April, 1955. This was followed by 119 in April, 1956, 181 in April, 1957 and 197 in April, 1958. The all-time peak figure of 201 was recorded in November of that year. April, 1959, produced an activity figure of 159, which had fallen to 121 in April, 1960 and is now below the 100 mark in April of this year.

It would appear that by another two years the DX HF bands, especially 28 and 21 Mc will be practically out of business, although the number of beam antennas now in use compared with the last minima will have some effect on the amount of DX worked. Conditions, too, will fall away on the 14 Mc band. It will be the late 1960s before we enjoy anything like the DX feasts of 1957, 1958 and 1959.

2WI JAMMED

AMATEURS in N.S.W. regretted the re-occurrence of the deliberate jamming of the VK2WI Sunday broadcasts after a lapse of some three years. Those replying to VK2WI during the morning expressed in no uncertain terms their opinions of the interference. VK2WI was transmitting on the 3.5 and 144 Mc bands and on 7146 Kc, the latter frequency being heterodyned. Those amateurs who may have thought the jamming was accidental were soon undertaken when the engineer, Dave Neff, VK2EO, switched on a fourth transmitter on 7050Kc.

He had been advised by telephone of the interference. This transmission was jammed within a few minutes of the commencement, both signals on the 7 Mc band suffering from a heterodyning carrier. It is considered that the culprit listens on 3.5 Mc to learn of the success of his efforts. By his work on this occasion he indicated he had at least two transmitters or possibly that two persons were concerned.

The real problem (VK2WI was over-riding the heterodyne in most country areas) is to understand the mentality of the person or persons concerned.

It appears they must obtain satisfaction from inconveniencing the many listeners to VK2WI. If it is a "pirate" seeing how effective his transmitter's coverage is, it would be an idea to await the arrival of a "ticket."

Several bearings were taken on the heterodyning signals and the location of the offender is gradually being narrowed down. He can rest assured that suitable action will be taken when he is apprehended.

CONTEST NOTE

THE final weekend of the CW section of the ARRL's DX contest did not provide many signals from the U.S. mainland on the 3.5 Mc band. The outstanding signal was from KL7AUG, who was peaking S7 around 0900 G.M.T. CE3AG was also audible, but was too busy contacting W's to react to calls from other areas. The 3.5 Mc DX has fallen away with approach of winter, but the odd W and JA are still appearing.

OVERSEAS VISITORS

TWO visitors to Australia in March were MP4BBW and W2DR, Ian, MP4BBW, one of the world's best known amateur SSB exponents, passed through Melbourne on his way to New Zealand and other parts. He had no difficulty in contacting 50 different countries a month on 14 Mc, using SSB from his home QTH, at Bahrein. Ian has accepted a challenge to work 100 countries on 7 Mc SSB between June, 1961 and June, 1962 and considers it will not be too difficult.

George Burns, W2DR, was a visitor to Sydney, where he was entertained by a number of amateurs. Vince Bennett, VK2VA, provided entertainment at his shack on one evening and VK's 2AGH, 2ADC, 2AIG, 2VN, 2AC, 2AJZ and 2BP assembled there for the occasion.

ELECTION RESULTS

RESULTS of further W.I.A. elections in N.S.W. are as follows: Hunter Branch — President, Stuart Fairbairn, VK2AYF; Vice President, Lionel Swain, VK2CS; Secretary, Gordon Sutherland; Treasurer, Bill Hall, VK2XT; Social Secretary, Les Baber, VK2RJ; Zone Correspondent, Keith Howard, VK2AKX; VHF Liaison Officer, Stan Lloyd, VK2AYL.

The N.S.W. VHF and TV group held their elections in April and the office-bearers appointed were Chairman, Barry Goodman, VK2ZAG; Vice President, Eric Phipps, VK2ZDP; Secretary, Bob Ridgely, VK2ZAR. The following are the members of the committee, VK2ZAH, VK2ZTM and VK2ZEW.

After the election of officers the retiring president, Bob Winch, VK2OA, lectured on VHF test gear covering all

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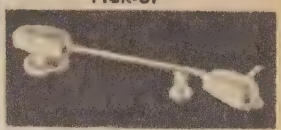

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ɔcts of such equipment. He an-ɔced the winner of the Chairman's ɔhy for 1960-61, first Dave Andrews, :AWZ, with 39 points, second was Cuming, VK2PM, 20 points with Norman, VK2ZCF, 13 points, il.

t the initial meeting for the year the W. Divisional Council appointed office bearers for 1961-62. The ɔrity of posts were filled but some ɔintments were held over to a sub-ent meeting due to lack of time. following officers were appointed: ident, Bill Lewis, VK2YB; Senior -President, Frank Hine, VK2QL; ɔr Vice-President, Max Pleffer, MP. Due to the amount of work ɔred by secretarial duties the position split into three appointments as lw: Divisional Secretary, Bob Luther, ZEL; Minute Secretary, Max Pleffer, MP; Disposals Secretary, Norm d, VK2ALJ. To simplify the secre-ɔ' work all mail should be address-ɔ Administration H.Q., 14 Atcheson ɔt, Crow's Nest, clearly marked to ɔate its purpose, Disposals, A.O.C.P., ls, etc. All QSL cards should be ad-ɔed as before to Box 1734JJ, G.P.O., ɔey.

ɔther officers appointed were ɔsurer, Bob Luther, VK2ZEL; ɔorary Solicitor, Bill Clark; Registrar, ll Storer, VK2EG; Education Officer, ɔld Burtoft, VK2AAH; Amateur ɔo Correspondent, Ted Whiting, ACD; Class Manager, Cec Bard-e VK2IR; Correspondence Class ɔager, Norm Beard, VK2ALJ; QSL ɔager, Frank Hine, VK2QL; Assist-QSL Manager, Syd Molen, VK2SG; ɔspheric Prediction Liaison Frank ɔ, VK2QL; Bulletin Officer, Vol ɔsworth, VK2VO; Publications Com-ɔe, Vol Molesworth, VK2VO, Norm d, VK2ALJ; and Phil Pearson, KZBB; Morse Practice Co-ordinator, rk Pearson, VK2ACQ; Publicity ɔer, Vol Molesworth, VK2VO; Dis-ɔls Committee — Chairman, Keith ɔ, VK2ABK, Dave Melbourne, KNK, Barnie Smythe and Vol Moles-ɔh, VK2VO.

ɔe Sunday morning VK2WI broad-ɔ will be presented by councillors on ɔster system.

NORTH COAST CONVENTION

ɔE North Coast and Tablelands Zone twelfth annual convention was ɔ over the Easter weekend at the ɔu popular venue, Urunga. An attend-ɔ of more than 50 enjoyed the com-ɔensive program arranged. The re-ɔ of the field events are as follows: ɔday—144 Mc Hidden Transmitter ɔ, first VK2RU, second VK2AHH, ɔ VK2RJ; Gerry Challender Mem-ɔ Contest 7 Mc Hidden Transmitter, ɔ winner VK2PY, the only successful ɔetitor. Ladies' Boat Race, first Mrs KPM, second Mrs VK2RU.

ɔnday—144 Mc Hidden Transmitter, ɔ VK2RJ, second VK2AHH, third ɔ VK3s holidaying in the area who ɔtsd the beam antennas. Urunga ɔnble, first VK3ALQ, 42 contacts; ɔd, VK2AHH, 41 contacts; third, KXT, 39 contacts. The special prize ɔ the longest distance travelled, KUX, from Ayr—1,200 miles.

ɔe new committee of the Moorabin ɔDistrict Radio Club have arranged a full and comprehensive program of events for the year. It includes Transmitter Hunts, film nights, visits to TV stations, etc. Theory and Morse classes are held every Thursday for intending amateurs and enthusiasts in the district are invited to contact the secretary for further information. He is Alf Chandler, VK3LC, 1013 High Street, Armadale, or ring BY3918.

N.S.W. Federal councillor Perc Healy, VK2APQ, who recently returned from a tour of the southern States, expressed appreciation of the hospitality provided by the VK7 gang. He attended a W.I.A. council meeting while in that State and met members of the W.I.A. Federal Executive when in Victoria.

The 288 Mc band has recently provided some good contacts for VK3 amateurs with VK5AW at Penola. VK3ZER is concentrating on working into VK7 on 576 Mc and several VK7s are co-operating. He intends working from a selected portable location.

ENGLISH TV

ENGLISH amateurs have been spanning greater distances with their TV transmission. G3OAT/T has been receiving 625 line pictures from G2WJ/T at a distance of just on 50 miles. Other amateurs have been setting further records for the relay of amateur TV signals and the figure now stands at 80 miles. TV transmissions are carried out on the 420 Mc band.

The British Amateur Television Club is very active and has published several booklets. Their booklet on "Slow Scan Television" is available from Don Reid, 21 Silverdale, Sydenham, London, SE26, at a cost of 2/6.

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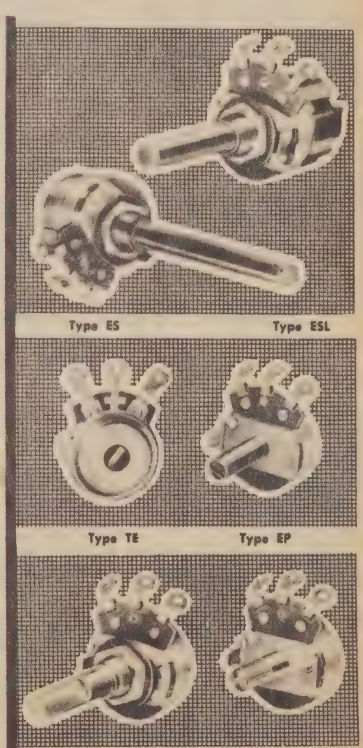

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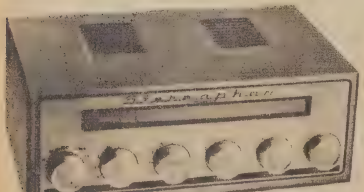

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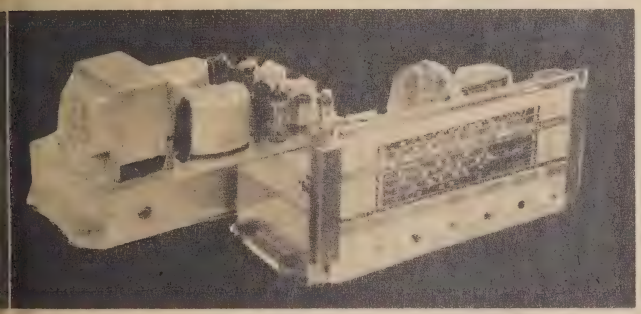
plete tuner and amplifier for stereo incorporating the "Mullard 2-2" amplifier circuit with separate bass and e controls. Output 3 watts per channel. Supplied with two Rola 8MX speakers. Frequency response 50 to 0 cycles. **£41/15/-** F.O.R.



ALL UNITS INCORPORATE THE NOW FAMOUS "MULLARD" AMPLIFIER & TONE CONTROL CIRCUITS.

Write for Full Specifications of STEREOPHONIC EQUIPMENT OR TAPE RECORDERS

SPECIFICATIONS OF OUR NEW HI-FI CHASSIS

NEW:

modern circuit using high gain valves including "magic eye" tuning ator. Permatuned iron cored coils and intermediates giving excel- interstate reception and a short-wave range of 12,000 miles. All used are the new Mullard nine-pin Innoval series.

NEW:

control and audio stages incorporating the Mullard 5/10 amplifier with separate bass and treble controls giving plus or minus boost or cut at 50 cycles L.F. and 10,000 H.F., combined with pull output with inverse feed-back gives you really high fidelity duction from your radio or favourite recordings.

NEW:

speaker combination using the new Jensen M.S.P. 12PR woofer matched tweeter and cross-over network giving a frequency nse of 40 to 12,000 cycles. If required the Rola 12MX speakers can pplied (with the 8 valve stereo chassis, two Rola 8MX speakers are plied). A.W.A. output transformers used on all units.

NEW:

Six position selector switch is incorporated in all chassis with compensation for L.P. recordings and provision for stereo F.M., or TV tuners and tape recorder.

NEW:

Large calibrated edge-lit dial in perspex (11in x 6in) with main stations of each State in prominent type. Dial fitted with counterweight drive, giving smooth tuning. Dial supplied in cream with matching knobs and escutcheon to suit contemporary blond or walnut finished cabinets.

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Sensitive "magic eye" tuning indicator (EM80) making tuning simple and positive even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, special plug being provided on back of chassis, also pick-up terminals and outlet for gramo. motor.
Power switch is fitted to volume control. Audio end of set can be used with TV receiver if required.

COMPLETE RANGE OF DUAL, COLLARO, B.S.R. AND GARRARD, STEREO PLAYING EQUIPMENT IN STOCK

Classic Radio

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Wafer Switches—assorted, from 1/ ea.
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Hansen S.C. Multimeter £7/6/
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Ferrocart V.T.V.M. £21/-/-
ALL PLUS 12½% SALES TAX.
FX300 Tape Recorder . . . . . 79 gns.

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with Crystal ear phone	£7/19/6
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RANGE — 500 - 1000YDS
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PISTOL GRIP SWITCH.
RUGGED CONSTRUCTION

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4,000-25,000 cps.
8-16 ohms. imp.
Power Handling Cap. 10 Watts—
Polished Walnut Cabinet.
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N.A.C. TRANSISTOR TELEPHONE SET

Two way communication up to 15 miles.
Highly efficient.

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BRAND NEW Quality Headphones
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182.5 M/G Channel 7
15 Valves
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Call or Write NOW! **290 LONSDALE ST., MELB. FB3711.** ***Trade Supplied***

ON SHORTWAVE — By ART CUSHEN

Change to Greenwich Mean Time

After the use of Australian Eastern Time for more than 20 years on this page, we change over this month to Greenwich Mean Time. The change is aimed at bringing these notes into line with world practice and providing greater convenience for our readers.

THE suggestion to change to GMT has been made by many readers ll, as it is now universal practice in th DX publications and short wave adcasting, we are sure it will be comed by short wave listeners gen-lly.

Greenwich Mean Time is based on ndon, and Australian listeners in th will add 8 hours to GMT, in elaide 9½ hours, Sydney and Eastern stralia 10 hours and New Zealand Fiji 12 hours. The 24 hour clock used, starting at midnight, so that a.m. is shown as 0100, 1 p.m as 0. The last two figures indicate the nutes, 1.15 p.m being 1315 hours IT.

RADIO USUMBURA

CEPTION of the broadcasts from Ruanda-Urundi has been verified by ydney listener.

News on the reception of this broad-s from the Belgian Trust Territory Central Africa is given by our reader, Roani, of Castlecrag, N.S.W. The tion uses 6195 Kc. with 10,000 watts, depends for its information on the itical Affairs section of the Mandated ritory. The verification came from il H. Van Molle, Broadcasting Man-r, and the address is P.O. Box 1400, mbara, Ruanda-Urundi.

The station is on the air 0430-0530 1000-1130, GMT, Sundays 0700-0, and 1500-2015 GMT. News is at 5 and 1800 in French, 1100 and 0 in Kirundi, 1110 and 1710 in yarwanda, and 1120 and 1720 in wahila. At 0500, 1300 and 2000 the tion relays the programs from the gian National Radio in Brussels. The tion broadcasts in French, Kirundi, yarwanda, Kiswahila and announces Usumbara, station de Radio fusion Ruanda-Urundi."

TESTS FROM SINGAPORE

INFORMATION from the Ministry of Culture, Broadcasting Division, ises that tests are being carried out our languages. The transmissions are the air from 1030 to 1430, in Tamil. nese, English and Malay are broad-on 6015, 6075 and 7250 Kc. The grams are; Tamil from 1030-1130, nese 1130-1230, English 1230-1330 Malay from 1330 to 1430. An itional series of tests is to be carried 4820Kc. The tests are identified by th frequencies in use, test 1 is on 5Kc, test two on 6075, test three on 0, and test four on 4820Kc. The erage of the station is for Singapore and Malaya, but reports from listeners in all parts of the world are appreciated. Reports should be sent to Radio Singapore, P.O. Box 1902, Singapore.

LAOS VERIFIES

A VERIFICATION letter by airmail in under three weeks has come from the Radio National Laos, broadcasting from the capital Vientiane. The station uses only 1000 watts and operates on 6150Kc. The verification was from the Director of Radio Laos, Thao Bounthamly, Director of the station. The station broadcasts from 2330-0100, 0500-0630 and 1100-1345. The station has news in English at 1300 GMT, then Vietnamese at 1315 and Chinese at 1330. The station is best received from 1300, at which time VLR6 in Melbourne signs off the frequency leaving the channel clear for the Laos signal.

SIGNALS FROM ATHENS

DETAILS on the broadcast from Radio Athens have been requested from one of our readers Mr C. Zaglas from Croydon N.S.W., and the following are the sessions which are best received in this area. In particular the afternoon transmission (here) is the most consistently heard.

0700-0815 in Greek on 9605, 11715 Kc; 0545-0815 Sunday on 9605, 11715; 0900-1000 on 9605, 11720; 1600-1700 on 9605 11720; 1715-1745 on 6075, 9605 in French and English; 1815-1845 on 6075 9605; 2200-2230 on 9605 11720 and 2300-2330 on 6075 and 9605 Kc. All broadcasts are in Greek with the exception of the transmission at 1715-1745 to Europe in French and English. The relay of the Church service at 0700 on Sunday is the best received transmission, but with 11715 Kc suffering from side interference from Melbourne on 11710 Kc.

TRANSWORLD RADIO ON 6115Kc

A NEW frequency for the English broadcasts from Transworld Radio have been heard, namely 6115 Kc. The session is on the air from 1915 to 2100 GMT, and was formerly carried on 6140 Kc. Arthur Harris, one of our Melbourne readers, reports the signals as excellent, when the other English session, from 0730 to 0800, has been tuned on 9705 Kc. Other transmission heard include in German from 1515 to 1555 on 7110 Kc. and from 1730 to 1755 GMT on 6075 Kc.

JAPAN EXTENDS BROADCASTS

RECENTLY Radio Japan in Tokio extended its broadcasting to 32 hours each day, and this was mainly due to the inclusion of a service to Africa and an increase from 10 to 13 daily transmissions in the General Overseas Service. The new transmission to Africa is on the air from 1930 to 2030 in English, French, and Japanese languages.

The programs also have shown some alterations following the opinions and wishes of listeners, and last year Radio Japan received over 230,000 letters from its listeners.

Some of the recent changes include the new frequency of 11875 Kc for the Australia-New Zealand service broadcast at 0930-1030 GMT and using also 15235 Kc. African Service 1930-2030 is on 9525 1170Kc.

North American service is now broadcast 0030-0130 using 17725, 15135, 2152 Kc. North and Latin American service is on the air 0300-0600 and uses 11700, 15135, 17725 and 21520Kc. Hawaiian Service from 0530 to 0700 is on 17725 and 15235Kc. The European service 0730 to 0830 is on 17725, 15135, 21610Kc. The second service to Europe, 1900-2100 uses 11800, 15135 and 9675Kc.

SCHEDULE FROM RADIO NORWAY

THE latest schedule of Radio Norway is as follows,

Times GMT	Area Served	Metre Band
0600-0700		
0700-1020 Sun	Home Program relay	13, 16, 19, 25, 49
1100-1215	Far East, Australia	11, 13, 16, 19, 25, 49
1300-1415	Europe, South Asia	11, 13, 16, 19, 31, 49
1600-2100	Europe, Africa	11, 13, 16, 19, 31, 49
2300-0020	South America	16, 19, 25, 31, 49
0100-0220	North America	19, 25, 31,49
0400-0520	North America (West Coast)	19, 25, 31, 49

Frequencies are 11 metres 25900Kc, 13m 21670, 16m 17825, 19m 15175, 25m 11850, 31m 9610, 49m 6130Kc.

INCLINOMETERS

Will measure angles. Ideal for builders, farmers, etc., for elevation, depression, drainage etc.

£7/10/- Each

Post, N.S.W., 7/1 Int., 9/6.

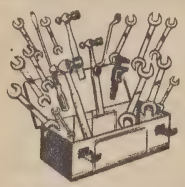
Waltham Pocket Watches
Ex U.S.A. Navy. Perfect condition.
£3/18/6 (Post 3/6).

SHIPS LOGS

Walker's Cherub Mk. III. Complete.
£25

SEXTANT

Husun with micrometer adjustment. Tested.
£25



SUPPLY RECTIFIER UNIT No. 13. NEW

INPUT. A.C.V. 240, 230, 220, 210, 200v. Also 190, 110, 120, 130v. OUTPUT D.C.V. 24v D.C. Tapped to give 2at 12v D.C.. 3 amps output. Voltage output can be increased in small steps to 28v D.C.

£12/10/- each

Freight payable at nearest Attended Railway Station.

NATIONAL TRANSFORMERS

For Scope soldering irons, new, 240V A.C. in 3.3V out at 30 amps.

38/6 each

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4¼-inch concave reflecting mirror, 12/6.
Eyepiece, low power, 1¼in F.L., £3 ea.
Eyepiece, high power, 5/8in F.L., £4/10/ ea.
Right-angle Prism, 2¼in square face £4/10/-
Small Erecting Prism ..... £1 ea.
Large Erecting Prism ..... 25/ ea.
Add Postage.

TELEPHONE HANDSETS

NEW SOUND POWERED
No battery required. Ideal television installation intercom., field telephones, etc.

55/- ea.

or £5 a pr. Post 5/-, Int. 7/6.

SPECIAL QUALITY TOOL OFFER

1 Set 6 SAE Set Spanners, sizes ¼in to 1in.
1 Set 6 WHIT. Set Spanners — 1/8in to 9/16in.
1 Ring Spanner, ¾in x 11/16in.
1 Open-end Ring Spanner, 11/16 x 13/16.
1 Ring Spanner, 11/16 x 13/16.
1 Tube Spanner, 14mm x 18mm.
1 6in Shifting Spanner.
3 BALL PEIN Hammers — 8oz, 16oz, 24oz.
1 pair 6in PLIERS.
1 15ft tow-rope with spliced loop and steel hook.
1 METAL TOOLBOX, 19in x 8in x 7in.

THE LOT FOR £6/15/6

3/- Cartage to Rail.
Freight payable at nearest attended Railway Station.

VOLTMETER

0 to 15 volt DC and 0 to 220 volt DC, with probes. In waterproofed Canvas Case.

33/6 each

Post: 3/1 Int., 4/.

OIL PRESSURE GAUGES

New. Suit cars, trucks, boats, stationary motors, etc. 0-150lb per sq. in.

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Liquid filled. As new. Ex-R.A.A.F. Ideal for small boats, etc.

£3/19/6 each

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TELEPHONES

Sound powered, can be used as microphone or receiver. New.

38/6 Pair

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A.W.A. COMMUNICATIONS RECEIVER

Type 2C8388. No. 24. Plug-in coils, 5 to 11 Mcs. with power supply and speaker.

£19/10/-

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PERISCOPES

10in x 4in x 1¼in. Contain two front silvered mirrors, 3¼in x 1¼in x 1/8in.

12/6 each

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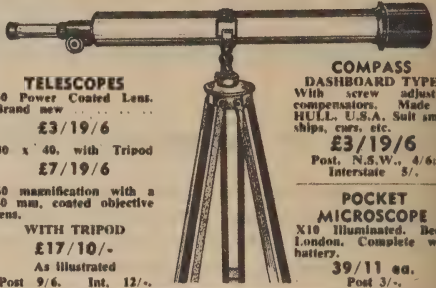
MANIFOLD PRESSURE or VACUUM GAUGE

29/6 ea.

NEW.
Post: N.S.W., 2/6; Int., 3/.



TELESCOPES

30 Power Coated Lens. Brand new .....
£3/19/6

30 x 40, with Tripod
£7/19/6

60 magnification with a 60 mm. coated objective lens.

WITH TRIPOD
£17/10/-

As illustrated
Post 9/6. Int. 12/-.

COMPASS

DASHBOARD TYPE.
With screw adjusting compensators. Made by HULL, U.S.A. Suit small ships, cars, etc.

£3/19/6

Post, N.S.W., 4/6; Interstate 5/.

POCKET MICROSCOPE

X10 Illuminated. Beck, London. Complete with battery.

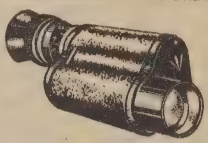
39/11 ea.

Post 3/-.

RANGEFINDER

Barr and Stroud Tubular Type. 4 ft length MK. V.

£12/10/-



PRISMATIC MONOCULAR

8 x 30, Ideal for Races, Football or General Viewing. This is the Monocular that is used as a telephoto camera lens. With Leather Carrying Case **£5/19/6**

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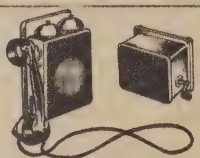
BALL BEARING.
1 3/8in diam., ¼in shaft, 30/ doz.
1¾in diam.., ¼in shaft, 42/ doz.
2 3/8in diam., 3/8in shaft, 54/ doz.
3½in diam., 3/8in shaft, 66/ doz.
Add postage.



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Ex. P.M.G. Wall-type. Complete with Magneto Box. Battery operated. Ideal long distances.

£4/15/- each or £9 pair

Freight payable at nearest attended Railway station.

Dashboard COMPASS

Small ships. Pioneer American. Liquid Damped with Light. Also suit as car compass.

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RT24/APX2 or B/APX1 15 miniature seven-pin ceramic valve sockets and covers, trannies, etc.

45/- each

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Ideal for fencing, aerial cables, etc. Suitable for wire up to 5/16in dia. 37/6 per set.
Post N.S.W., 7/. Interstate 9/6.

TRANSFORMER AND RECTIFIER UNIT

New U.S.A. 240 A.C. 110-115V. Unit operates at 110v-115v D.C. at approximately ½ amp. out. from 240 V.A.C. in.
ALSO HAS A STEPDOWN TRANSFORMER 240 V.A.C. 100-115 V.A.C. AT 5.33 AMPS.
The unit has three outlets for A.C., two outlets for D.C., and will operate all voltages input around 240 V.A.C. and 110 V.A.C. has many input tappings, also has 110V rectifier choke and two 500 M.S.D. capacitors. Stepdown transformer 240V to 110V A.C. £10 or

Complete Unit £12/10/

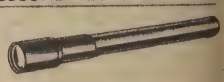
Freight payable at nearest attended Railway Station.

COMPLETE TRANSMITTER NO. 133

A.W.A. type 351050 comprising R.F. unit, power control and minor rectifier unit and main rectifier unit, with spares. 100 watt R.T. 300 watt C.W. Crystal controlled 2 to 20 mcs, with power supply. 110 or 240 volt A.C. 50 cycle. New. Will transmit over 500-mile range daytime. World range night. Original cost £2,000. Heavy-duty wide band aerial included.

£125 COMPLETE

SECOND HAND £75 each



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Ideal Rifle or Dumpy Level Sight.

47/6 Post, N.S.W., 3/1 Int., 4/.

GUNSIGHTS

Contain these lenses:
1 lens 1in Focus, ½in diam.
1 Lens 1 11-16in Focus, 1¼in dia.
1 Air Spaced Lens, 1¼in diam.
1 Filter Lens. 1 Graticule.
1 Lampholder.

18/6 each Post: N.S.W., 2/6; Int., 3/.

DEITCH BROS.

70 OXFORD STREET, SYDNEY Between Crown and Riley Streets, City.

AFRS BROADCASTS

THE Armed Forces Radio Service in New York is on the air very day from 1430 to 2245 GMT, id since the introduction of some wer frequencies, is giving excel- nt reception towards the end of transmission. At the moment, it using the following frequencies id schedules.

30-2000	WDSI-1, 21650 Kc
30-2100	WBOU-6, 17780 Kc
15-2245	Munich-7, 15280 Kc
00-2245	WBOU-6, 15370 Kc
00-2245	WBOU-1, 15185 Kc
15-2245	WDSI-1, 11905 Kc
15-2245	WBOU-5, 9525 Kc

DDIS ABABA is being again re- d with its test transmissions to pe and West Africa. The trans- ons are on 11955 and 17775 Kc. dcasts from 1815 to 1845 GMT, English for the first 15 minutes, the remainder of the broadcast in ch.

APPY STATION program from ersum, Holland, is now on the air much more suitable time for listen- The new transmission is from 0600- , and the station uses 9715 and 0 Kc. The genial host, Eddy Startz, ructs the session as he has for the 32 years in this Sunday program Holland. Excellent signals are also received by Lloyd Reynolds, of abri, N.S.W., who hears the Happy on best in the 9715 Kc outlet.

ABAT, in Morocco, continued with experimental broadcasts, and an ish report now lists the frequency 1735 Kc. The station is on the air the English portion of the broad- s from 1800 to 1830, and this is wed by a session in French.

TRONDHEIM station, in Norway, relays the Home Program on short wave, from 0530-0800 on 9550 Kc, 1020-1400 and 1430-2330 on 15170 Kc.

ISRAEL, with broadcasts from Jerusalem in the programs of Kol-Israel, is broadcast on the following schedule; 1645-1715 GMT in English, 1745-1800 Spanish, 1800-1815 Russian, 1815-1845 in Persian, 1845-1900 Rumanian, 1900-1915 in Hungarian, 1915-1945 in Yiddish, 1945-2015 in French, 2015-2045 in English, 2100-2130 in French, 2130-2200 in English. At times, transmissions are on 9009 and 11920 Kc.

DAMASCUS, in Syria, is broadcasting to Europe from 1930-2030. The period 1930-2000 is in French, and from 2000-2030 in English. The broadcast is now on 6165 Kc. The Arabic home service is still on 5705 Kc.

PERUVIAN station "Radio Nacional" in Lima is reported from North America as using two new frequencies, namely 9530 and 9610 Kc. In the past, the station broadcasting from Lima has been heard on 6082 and 9565 Kc, when sign off is at 0500 GMT. Occasionally, when closing, a short identification announcement in English also has been given.

Notes from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Greenwich Mean Time, 10 hours behind Australian Eastern Time.

GOA, in Portuguese India, is now using a new frequency, 6085 Kc, for its daily broadcasts. The station uses 10 Kw on this channel and is on the air from 0130-0900 and 1100-1830. A 50 Kw transmitter is used on 21580, and this transmitter is on the air 1630 to 1830 GMT.

SWEDEN'S LANGUAGE SCHEDULE

SOME recent changes in the schedule of Radio Sweden are now included in a recently revised transmission list.

Times GMT	Frequencies	Language
0000-0145	11705, 11805 Kc	Swedish
0145-0215	11805	English
0215-0315	11705	Portuguese, Spanish
0330-0345	11805	English, Swedish
0400-0445	11705	Spanish
1230-1345	15240, 17840	English
1345-1600	15240, 17845	English, Swedish
1615-1730	11705, 15240	English, Swedish
1745-1900	15240	English, Swedish
1915-2015	11705	German, English
2030-2100	7210	English

MAURETANIA Radio, at St. Louis, now issuing a tan and yellow card, also sends a set of Senegal stamps, cording to a listener in New York. verification was by letter only, but stamps were included, so readers uld look for this one in the winter. are heard on 4855 Kc, and the missions are from 0700-0830 and 2345. The other session, 1215-1330 T, is now on 7245 Kc instead of Kc as formerly.

BAMAKO, which identifies as Radio has been noted on 7075 Kc, from to after 0800.

GHANA, with its broadcasts from Accra, has been noted on a new frequency on 11800 Kc, and is on the air from 1700 to 2215 GMT. The station carries the same programs as on 4915 and 3366 Kc. The station at 1800 has a program in English, and one for Ghana troops in the Congo, while at 1930 a news bulletin in French is broadcast.

NIGERIAN West Regional station at Ibidan can be heard from 1630 to 2200 hours GMT on 3204 Kc, while at 0530 the station has been heard in Europe

(Continued on Page 111)

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250 V. D.C. at 150 mA
Fil. 6.3 V. at 5.0 A
Dimensions: Height 3¾"
Width 3⅛"
Depth 3¾"

Front view of
Unit Amplifier No. 2

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The Unit Playmaster No. 2 was designed by "Radio, Television and Hobbies" and featured in the August, 1960, issue. NATIONAL have designed these components specifically for the Unit Playmaster, and the kit is available from all electrical wholesalers. If further details are required, write immediately to NATIONAL.

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Watts—Rating 15 W.
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Width 2⅜"
Depth 2⅜"

FILTER CHOKE RH 3/150
FILTER CHOKE RH 3/160
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Current: 150mA
D.C. Resistance. 100 ohms
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msa15C

ANSWERS TO CORRESPONDENTS

HY DO CAPACITORS REDUCE HUM?

(West Perth, W.A.) asks if we be able to arrange for an advert to be on the page backing Buy An Argument" each month ilitate filing. Also if it would be le to publish more articles on anivilisations, etc. He wonders if ould explain how a capacitor " hum in radio equipment.

We are afraid that we cannot ntee to please in the matter of ent of advertisements, F.J., be in the overall composition of agazine, there are many other fachich we must take into considera-

for the articles on subjects of ological and anthropological interore of these could only be fitted he expense of other topics, which e have their following.

acitors, by their nature, present pedance which is conscious of the applied to them. If we apply a or DC voltage across a capacitor, nstance, it will behave under state conditions (i.e., after the initial charging transients have finished or become practically zero) as an infinite impedance.

If we apply a voltage which is changing, such as a periodically reversing AC voltage, however, the capacitor will act as a much lower impedance. The faster the voltage changes (i.e., the higher the frequency of the AC) the lower appears the impedance of the capacitor.

This explains why a capacitor can be used to remove hum, which is really the presence of a fairly low-frequency AC voltage among ideally steady voltages. If we place a capacitor directly across a voltage which we desire to be free of the AC hum voltage, it will present a low impedance to the AC "ripple" part of the voltage, but an infinite impedance to the steady or DC part. Thus the hum will tend to be shorted out or reduced (if not removed) by making the capacitor large in value so that it presents practically an "AC short-circuit." The steady or DC part of the voltage will be unaffected—apart from being "hum-less" of course.

(Oyster Bay, N.S.W.) sends us s of his success with a number of ccuits, including a modified version "Stereo Amplifier from Oddment with which he is particularly He expresses his sympathy at issing of the late Editor, Mr and wishes the magazine "all the or the future.

Good to hear of your successes, nd we hope you have as much with your future projects. We eate your sympathy regarding Mr and thank you for your kind e for the future.

★ ★ ★

V. (Laverton, Vic.) asks if we explain the operation of Magne-s.Klystrons and waveguides in the e Your Answer, Tom" section of agazine. He also feels that some ation on Lissajous Figures would seful.

Thanks for the suggestions, E.J.W. e are no doubt aware, we are at n presenting a series of "Answer about measuring instruments, and ill not be able to follow up your r a while. However, we will cerbear them in mind when the prees comes to an end.

★ ★ ★

(Woodville Sth., S.A.) refers to ntion of an S.T.C. tunnel diode ne, 1960, issue, and asks if we publishing results of our experiwith this unit. He also asks if nel diode is available to the genblic. Finally, he inquires whether ly covers suitable for the filing volume of the magazine.

s far as we are aware, B.C., the unnel diodes (types JK11A and A were developmental types only w not be made available for gene-Later types may be available in urse, however.

our experiments with the tunnel e hey have not as yet reached a where we can forecast when we shall be able to publish the results. As you no doubt noticed in the February issue, we have been able to offer a theory article on the units, but we are afraid you will have to be patient as regards the practical experiments.

Volume folders are available for the magazine, and correspondence should be directed to our Periodical Back Dates Department, John Fairfax and Sons Pty. Ltd., Hunter Street, Sydney.

★ ★ ★

B.S., of Malvern, S.A., writes to ask if the number of turns specified for the primary winding on the ferrite rod used in the "Transporta Seven" receiver is the correct value and also whether such a set would function with a car aerial.

A.: We can assure you, B.S., that despite the assertions of your friend, around about three turns will be quite sufficient for attaching an external aerial to your receiver. Just how the set will function when connected to a car aerial is problematical, but we have never sought to encourage the practice. At the very least it will be necessary to take normal precautions against ignition hash and generator whine.

There is no need to touch the other windings when it is used with a car aerial and in like manner there will be no effect on the operation of the ferrite rod by the presence of the coupling coil. One obvious problem is, of course, that the loop will pick up any electrical noise present inside the car, adding it to the signal picked up by the aerial.

This latter problem would not occur with an AC set operated from an inverter but then few AC sets have the kind of RF performance which is desirable for auto reception. Basically, the only way to be sure of good results would be to instal a regular car radio.

RADIO, TELEVISION AND HOBBIES QUERY SERVICE

TO assist our readers, "Radio, Television and Hobbies" conducts a technical query service. Conditions governing this service are set out below:—

(1) Requests for copies of circuits or technical queries requiring an answer through the post must be accompanied by postal note or stamps to the value of TWO SHILLINGS. Queries not accompanied by a fee will be answered in rotation on these pages.

(2) For the 2/ fee, we will supply circuit data, as available, for up to three projects. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. As a rule, requests for circuits will be answered more speedily if they are clearly identified and not complicated by questions requiring the attention of technical personnel.

(3) The technical query service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits.

(4) The Editor reserves the right to return query fees or to limit the scope of an individual reply, where it is felt that a partial answer will be better than none at all. Please note that the inclusion of an extra fee does NOT entitle correspondents to special consideration.

(5) In addition to the normal query service, chassis blueprints are available for most of our projects, showing the position of all holes and cutouts for metal-working but containing no details of wiring, etc. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost 5/ each. Original photographs of most projects are also available, from 5/ for a 6in x 8in glossy print; postage 9d extra.

(6) Letters should be addressed to the Technical Editor, "Radio, Television and Hobbies," Box 2728, G.P.O., Sydney.

(7) "Radio, Television and Hobbies" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications of merchandise must be obtained from our advertisers.

(8) Technical queries are not answered by telephone.

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10. Porta player
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12. S/W Conv. (batt.) 2
13. S/W Conv. (A.C.) 1
14. S/W Conv. (A.C.) 2
15. All Wave Conv. 1
16. All Wave Conv. 2
17. 50 Mc/s Conv.
18. 144 Mc/s Conv.
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20. Playmaster Stereo Control Unit No. 10
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22. Playmaster Tuner No. 3
23. Playmaster Program Source.
24. Mullard 3-3 Amp
25. Mullard 5-10 Amp
26. Mullard 5-20 Amp
27. Playmaster 10w
28. Playmaster 17w
29. Mullard 2-2 Stereo
30. Unit 2 Stereo
31. Playmaster 10w Stereo Amp.
32. Playmaster 17w Stereo Amp.
33. 13w PA Amp.
34. 25w PA Amp.
35. 35w PA Amp.
36. 50w PA Amp.
37. 10w Guitar Amp.
38. 20w Guitar Amp.
39. Transistor 1
40. Transistor 2
41. Transistor 3
42. Transistor 4
43. Transporta 6
44. Transporta 7
45. Transporta (RF) 7
46. Transistor 8
47. Transistor D/W 8
48. Transigram 4
49. Transistor Stereo Amp. 2 watt
50. Transistor Stere Amp. 4 watt
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52. Transistor 10w Amplifier
53. 3" C.R.O.
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57. Transistorised Wavemeter
58. Sweep Genera
59. G.D.O. Adapte
60. Pattern Gener

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MELBOURNE

THE CHEMISTRY OF FIREWORKS

(Continued from Page 14)

when ignited, thus producing a long nt-shaped ash. The chemical is i with a little gum arabic and salt- and formed into egg-shaped pellets. e popular Catherine wheel is oned by filling a paper tube with iesired composition and rolling it a circle round a wooden centre. rolls are tied together so that they not straighten out during operation. n a pin or nail is driven through centre and the device ignited the ant burning of the composition ices the same reaction as that of a t so that the reaction will cause wheel to revolve.

similar action is obtained in a com- display by attaching interconnect- ring tubes round the periphery of wheels. By this means beautiful s are obtained by altering direc- of rotation, the emission of colour- es and so on.

e firework known as "jumping jack" is merely a paper tube filled with firing composition. The tube is blocked off along its length usually by twisting and the whole bent back and forth at acute angles. When ignited, the burning of the composition causes a reaction similar to the rocket which causes the device to jump around. The blockages in the tube cause the explosions.

The familiar "sparkler," popular and safe for the small kids, consists of steel wires dipped in a composition of sulphur, fine aluminium powder, steel filings, charcoal, potassium chlorate and dextrin. There are many variations of this so that, by the addition of the proper chemicals, various colours can be obtained.

We have not dealt with the construction of "squibs," bungers, double bungers and so on as these are mere paper cases filled with an explosive mixture. They are just miniature bombs.

The description of the devices in our text gives some idea of the methods employed by the pyrotechnician to bring about various effects. Larger displays merely use more complex versions of the principles outlined above. It is a matter of chemical composition coupled with tubular constructions containing bends, obstructions and methods of fusing by means of wicks and so on.

By proper design, timing and construction the pyrotechnist can produce wonderful effects from the most primitive of common "crackers." Even the amateur can produce such effects instead of the random explosions by connecting the various devices by means of lengths of match wick. It is worth trying.

STANDING-WAVE INDICATOR UNIT

(Continued from Page 45)

ngs are the same as those obtained e first instance, the instrument is metrical.

I use the instrument, connect it hen the transmitter and the feedline, the switch to the "forward" position djust for a full-scale or near full- reading; then turn to the "reflected" ion. The reading obtained in this ion should be close to that obtained the dummy load. Adjust the na or antenna tuning for a mini- reading in this position, consistent a maximum reading in the ard" position.

hen using the unit to indicate aerial nt or to compare plate current dip maximum RF on the line, use in forward" position.

is unnecessary to remove the unit testing has been completed, it may ft in circuit at all times, where it ovide a good indication of antenna ransmitter performance.

you have a low-power transmitter ind some trouble in getting suffici- eading in the "forward" position the sensitivity control flat out, use ger piece of coax. and wire for onal pick-up Alternatively, use a sensitive meter movement.

OOTBALL TRAINING

SKY footballers may soon be wear- ing "hearing aids" as part of their r training schedule following an ment with Britain's famous al Soccer team.

In the experiment, conducted by s Electrical Ltd., each player was ped with a receiver, carried in ster-type carrier of cloth and elas- d fitted with a standard earpiece. ough a microphone on the touch- he coach issued instructions to the s. The only other equipment was p of wire running around the oval ate a magnetic field.

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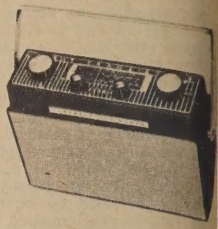

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1 x Philips GM2891 TV Pattern Generator—condition good £75

1 x "Kay" Magapix 10-channel crystal controlled sound and video generator—condition good £450

1 x "Kay" Model RF—P10 channel crystal controlled TV sweep generator—condition good £400

1 x "Kay" Model I.F. crystal controlled I.F. sweep generator—condition good £230

1 x "B and K" Dynascan picture and pattern video generator—has been converted for video output only—condition good £20
Ditto—condition fair £18

1 x Taylor Model 31A cathode ray oscilloscope—condition good £7

1 x "R.C.A., TV Eye camera, complete with R.F. output unit, tripod, lens and sighting gear. Condition good £40

1 x Boonton Sweep Generator with 2 univertor units—con dition good £80

All prices of the above are Nett excluding freight.

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1 meg. ohm ½ watt Carbon ± 10 p.c.	3/6 dozen	.02 x 600v Paper Tubular ± 20 p.c.	8/6 doze
470,000 ohm ½ watt Carbon ± 20 p.c.	3/- dozen	.022 x 1000v Paper Tubular ± 20 p.c.	14/ doze
47,000 ohm ½ watt Carbon ± 10 p.c.	3/6 dozen	.0022 x 600v Paper Tubular ± 20 p.c.	7/- doze
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75 ohm ½ watt Carbon ± 10 p.c.	3/6 dozen	.001 uf Mica type P/T ± 10 p.c.	12/- doze
100 watt ½ watt W/W	4/- dozen	.002 uf Mica type S/M ± 10 p.c.	18/- doze
47,000 ohm 1 watt Carbon ± 20 p.c.	4/- dozen	.005 uf Mica type S/M ± 20 p.c.	25/- doze
330 ohm 1 watt Carbon ± 10 p.c.	4/6 dozen	.01 uf Mica type S/M ± 20 p.c.	30/- doze
4,700 ohm 1 watt Carbon ± 10 p.c.	4/6 dozen	70mfd x 50 vw Electrolytic type ET4D	3/3 eac
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IN REVIEW

By Julian Russell

(Continued from page 93

...ucted by Eugene Ormandy. ...net Stereo KLCS2723.

...Symphony No. 4 in E Minor. ...harmonia Orchestra conducted ... Herbert von Karajan. World ...ord Club Mono TE221.

...sky — Sleeping Beauty Suite ... the Ballet. Philharmonia Or...ra conducted by Efrem Kurtz ... Yehudi Menuhin (solo violin). ...' Mono OALP1790.

...rand Canyon Suite; Missis...pi Suite. Hollywood Bowl Sym...y Orchestra conducted by ... Slatkin. Capitol Stereo ...87.

...e Planets. Suite. London ...phony Orchestra conducted by ... Malcolm Sargent. Decca Ace ...lubs Mono ACLA 26.

... Returns to Carnegie Hall. ...popular Negro singer presents ...aried program with Odetta, ...m Makeba, the Chad Mitchell ... and the Belafonte Folk Sing... RCA Stereo SLB 10990/1.

... — The Mikado. Complete. ... Brannigan, Richard Lewis, ...int Evans, Ian Wallace, John ...eron, Elsie Morison, Marjorie ...nas, Jeanette Sinclair and ...ca Sinclair with the Glynde... ...ne Festival Chorus and Pro ... Orchestra conducted by Sir ...olm Sargent. HMV Stereo ...P 1485/6.

...N SHORTWAVE

By Art Cushen

(Continued from page 105)

... Kc, when a news bulletin in ... carried.

...LAND station Radio Loame is ...67 Kc from 0600-0800 and from ...0 GMT. When telegraphic in... permits, the best signals are ...ours.

... COAST, which we recently ...on 11820 Kc with the programs ...idjan, is reported to have used ...gency as a replacement for 7215 ...station is on the air daily from ...0800 and 0845 to 2400, with ...French at 1830 and in English ...5 to 1915 hours GMT. These ...an be heard only from Monday ..., GMT date.

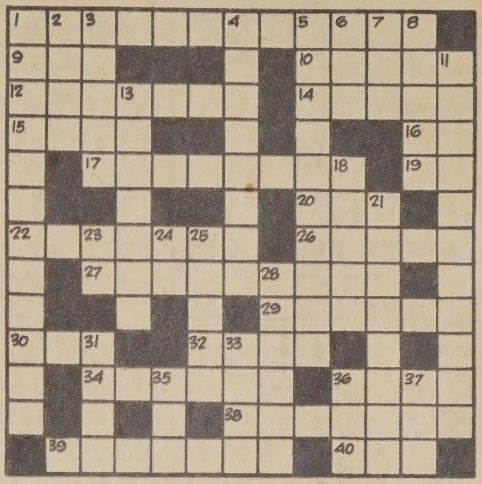
...T MINUTE ITEMS

...appy Station program from ... Netherlands has made a fre... ...ange. It is now heard on 9715 ... excellent signals 0600 to 0730 ...ys) and a new 25 metre fre... ...f 11915 Kc, but this suffers ...erference from HCJB. We have ... the Holland channel of 11945 ...h would give clear signals in ... Initial broadcast resulted in ...reports to Radio Netherlands ...eners in Australia and New ...

...n Portuguese India, is now ... frequencies for the early trans... ...rom 0130 to 0900, the new ...eing 9690 Kc. The other trans... still on 6085 Kc.

...New Zealand's DX Session is ...dcast on the first Wednesday ...onth, at 0640 and 1030 GMT ...080 and 11780 Kc.

THE R., TV & H. CROSSWORD No. 84



ACROSS

1. The fixed plates of a tuning capacitor.
9. Prepare an iron.
10. Parts of transformers.
12. Attracts.
14. Type of water.
15. Check.
16. Measure.
17. Stagnant water.
19. Type of coupling network.
20. In the centre.
22. Having a leaning towards.
26. Nearly.
27. Coated with metal.
29. Sense of sight.
30. Prefix, new.
32. Man's name (abbr.).
34. Roof timber.
36. Honolulu is on this island.
38. Ministers.
39. Location of film studio.
40. The kidney.

DOWN

1. Binaural sound.
2. Part of a fork.
3. Grotesque.
4. Type of amplification.
5. Without colour.
6. Digit.
7. Age.
8. Cut.
11. At the same time.
13. Inherent property of matter.
18. Means of delineation.
21. Devote wholly.
23. Right. (abbr.)
24. Preposition.
25. Horrify.
28. Thoroughfare.
31. Precious mineral.
33. Insects.
35. Rubbish.
36. One of a pair.
37. Bird.

Last month's solution

B	O	O	S	T	E	R	S		M	A		
	V		E		R			T	O	S		
M	E	R	C	U	R	Y	S	W	I	T	C	H
O	R	I	O	N		A	T		E	T	A	
S	T	O	N	E	T	H	E	C	R	O	W	S
S	O		D		R	O	A	R	S		E	
	N			M	O	O	D	Y		L	R	
B	E	A	T		P		Y			I	I	
A			H		I	N	S	U	L	A	T	E
N	O	D	E		C	A	T	S		I	S	
K		O		S	P	A	H	I	S			
E	X	T	R	A			T	E	N	O	R	
D		Y			V	E	R	A	N	D	A	

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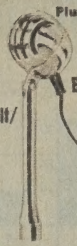

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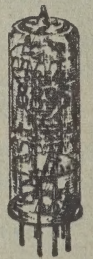

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